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CONTENTS.

Editorial 117
Dark Light Photography 119
Acetylene Gas 119
Central-Station Working—V. and VI., by A. N. Rathbun and H. W. Frund 121
Acetylene Gas 123
The Form Factor of Alternating-Current Curves, by Prof. J. A. Fleming 123
Photometry of Differently Colored Lights and the "Flicker" Photometer, by F. P. Whitman 124
The Milwaukee Meeting of the Northwestern Electrical Association 126
Electric Elevators, by Frank J. Sprague 128
Regulating and Starting Rheostats, by Geo. R. Colgate 131
The Lachmann Conduit Electric Railway System, by R. W. Barkley. 131
Digest of Current Technical Electrical Literature, Compiled by Carl Hering 132
Test of an American Incandescent Lamp 135
Theatre Electric Railway Cars 136
Electrolysis from Electric Railway Return Currents 136
Gang Drills 137
A New Hinge for Telephone Box 136
The Yale-Weston Chain Hoist 137
Oil Purifier 137
Table for Determining Sizes of Commutator Bars 138
DEPARTMENTS:
Financial Intelligence 139
Special Correspondence 139
General News of the Week 141
Personal 143
Trade and Industrial Notes 143
Business Notices 144
Illustrated Record of Electrical Patents 144

ELECTRIC ELEVATORS.

In another column we print in abstract the recent Institute paper of Mr. Frank J. Sprague on electric elevators, which, it is scarcely needful to say, forms the most important contribution yet made to the subject. Owing to the limitations of space, that part of the paper enumerating in detail the advantages of electric over hydraulic elevators had to be omitted from the abstract, and we will therefore say here that figures and arguments were adduced proving the superiority of the former in every material respect, but particularly as concerns economy of space and operation. Six electric elevators of the type described have been in operation for almost two years in the building in which THE ELECTRICAL WORLD has its home, and we are therefore in a position to speak as to their practical efficiency. This was the first extensive installation, and therefore, in a sense, an experimental one; but, nevertheless, so thoroughly had all the problems entering been solved that every claim made has withstood the test of practice, and what this test means may be appreciated from the fact that 12,000 passengers are carried daily. It is not often that to one person is due the credit for developing two great industries, and the work ot Mr. Sprague in connection with the electric railway and the electric elevator therefore assigns him to an unique place among those who have done most toward making the present era essentially the Age of Electricity.

INCANDESCENT LAMP INEFFICIENCY.

Those who have followed closely the proceedings of bodies of practical men, will doubtless have noticed the tendency toward the widest divergence of opinion in the discussions, which characteristic may indeed be said to amount to a hall-mark. Several examples of this were furnished at the recent Milwaukee meeting of the Northwestern Electrical Association, the most notable being in the discussion on central-station economy with respect to incandescent lamps. One speaker advised central-station men to use 2½-watt lamps and even to seek for 2-watt lamps, while another was cautious about recommending an efficiency as low as 3.5 watts. Superficially the statement that 2½-watt lamps, with a life of 300 hours, are more economical than 3.1-watt lamps having a life of 600 hours, has an appearance of reason, but, as shown by Messrs. Terry and Howell in the discussion printed in abstract in another column, it ignores several factors of the utmost practical importance in the present state of the incandescent lamp art, and of central-station operation. As incandescent lamps are made at present, the higher beyond a certain point the efficiency at which they are burned, the greater the deterioration in candle-power, and the less the ability to stand fluctuations in voltage. If, therefore, the voltage of currents were kept constant, it would not follow as a matter of course that the lamp of higher efficiency would give the best average result; while, under the conditions as to regulation in the majority of plants, the use of lamps of very high efficiency becomes impossible under the present methods of their manufacture. The discussion brought out very strongly the necessity of close regulation of voltage if satisfactory results are to be obtained from lamps of even 3.1 watts efficiency, and will have performed excellent service if greater attention is thereby directed to that important point. Immensely greater, however, will be the benefit, if it will impress on lamp manufacturers and inventors the absolute need of the incandescent lighting industry, under present conditions as to competition from other sources of light, of a high efficiency lamp that will have the same qualities as to life and maintenance of

candle-power of, say, the present 4-watt lamp. As pointed out by Mr. Beggs, gas manufacturers have been urged by the competition of the electric light to vastly improve their product, until at present the candle-power of a 5-foot gas jet reaches 20, 24 and even a higher candle-power. As a consequence, the 16-candle-power incandescent lamp, which owed some of its early popularity to its superiority in light over the then 10 and 12-candle-power 5-foot gas jet, has been placed in an unenviable position of inferiority, and the "sickly incandescent lamp" has become a phrase too frequently repeated. Whether with the present class of filament and method of manufacture it is possible to hope for a 50-watt 24-candle-power lamp that will have a life with sustained candle-power of over 300 hours with the fluctuations of voltages encountered with alternating systems and many direct-current plants, seems a matter of some doubt. In order for incandescent lighting to keep in the van it seems imperative that something be done, and by working along new lines the desired relief may be obtained.

ACETYLENE GAS.

A paper read before the recent meeting of the Northwestern Electrical Association at Milwaukee, an abstract of which we print in this issue, contains a very enthusiastic account of acetylene gas, together with some abuse of technical journals which have ventured to criticise the commercial value of the new gas for illuminating purposes. Though addressing an electrical association, gas companies are gratuitously informed that if they "will obtain the rights for the use of the new gas, they will have a weapon which will be as much stronger than the Welsbach burner as the acetylene flame is stronger than the Welsbach light." The statement was made at Milwaukee that acetylene gas can be produced at a maximum cost of $3 per thousand cubic feet, and that its illuminating power is about eight times that of common gas. On the other hand, the promoters of acetylene gas claim that its equivalent illuminating value is theoretically 30 times that of coal gas, and "practically" 40 times as great. Accepting for a moment the first-named figures, the second of which is the same as that given by Prof. Crafts, we have a basis of comparison with ordinary illuminating gas. The city of Philadelphia purchases illuminating gas at 35 cents per thousand feet at receivers, and the cost of manufacturing such gas is placed at a figure as low as 17 cents per thousand feet when manufactured in large quantities or by the latest methods. The equivalent cost of acetylene gas, as deduced from the above figures, is 37½ cents per thousand cubic feet, so that even according to the statement of an ardent partisan, it cannot be manufactured as cheaply as ordinary illuminating gas. That the advocates of acetylene should persistently ignore all other cost items than that of bare manufacture, would in itself seem to indicate that they do not feel their position to be as sure as they would like the public to believe. But, apparently to evade consideration of the outlay for distributing plant, cost of distribution, questions of franchises, etc., it is said that gas may be supplied in reservoirs to the consumer. In this respect, however, acetylene gas has no peculiar advantage over ordinary illuminating gas, that method in fact, being employed in the Pintsch system of lighting railway trains. Should such a system of distribution be commercially feasible, it is quite probable that the Pintsch plants in various cities would before this have entered into the supply of gas in cylinders for house lighting. The fact that a larger reservoir would be required for illuminating gas, would not, we believe, prevent competition of the latter, as the linear dimensions of the larger reservoir would only be about twice greater than that containing an equivalent quantity of acetylene gas under the same pressure, and, therefore, would not be of impracticable size for ordinary residence lighting, if we accept the dimensions given for acetylene gas reservoirs for the same purpose. Should acetylene gas for house lighting also require an admixture of air in order to reduce the intensity of the jet, it would be seriously handicapped on account of the attendant danger of explosion. We learn from Prof. Crafts that the gas mixed with air forms a powerful and dangerous explosive, and it would, therefore, be extremely hazardous to introduce into a house installation the necessary device for diluting the gas with air. The figures given for the "cost" of acetylene gas recall the misconception that existed even a few years ago, as to the "cost" of electrical energy. In one instance, three engineers of undoubted competency gave the cost of electricity delivered at incandescent lamps at 0.8 cent, 2½ and 4 cents, respectively, per horse-power-hour, notwithstanding the fact that at a selling price of 12 cents per horse-power-hour, but a small percentage of electric lighting companies were able to make both ends meet. In the case of acetylene gas, however, the presumption of good faith is not always present, for aside from leaving out leakage, fixed charges for distribution, wages of inspectors, metermen, etc., the estimates for cost of manufacture have been absurd, as, for example, in basing them on a cost of electrical energy delivered at the carbide furnace electrodes, at $10 per yearly horse-power on a 24-hour basis, when the cost will be more than twice that in the new carbide works at Niagara, using the cheapest electrical power in the world. Central-station owners will do well before being tempted by the bait dangled before them —that they can utilize their present facilities for the manufacture of calcic carbide—to substitute the cost of generating an electrical horse-power-year in their stations in the estimate on another page, offered by acetylene promoters, as representing the cost of producing calcic carbide. At the same time it would probably not be amiss to increase the other items in the estimate in the same proportion as the cost of the electrical energy, and not for a moment lose sight of the fact that the resultant cost of acetylene gas should be compared with the mere *cost of manufacture* of coal gas—that is, from 17 to 27—cents per thousand cubic feet, and not with the cost of coal gas delivered, which may be from $1 to $1.75 per thousand and yet not yield more than a legitimate profit.

The Naval Reserve.

An Engineer Division of the Naval Reserve, Battalion of the East, is being organized, the matter being in the hands of a committee consisting of B. Franklin Hart, Jr., 490 Bloomfield Street, Hoboken, N. J., and Everett W. Frazar, Orange, N. J. The purpose is to have a corps of men thoroughly equipped to meet all the exigencies of the service that require technical and mechanical skill. It is proposed to give the men practical and theoretical instruction in the running of the engines, and general management below decks of ferry-boats, tugboats and modern war ships; a comprehensive course of study and practice in the manipulation and principles of electricity in all its branches, particularly those relating to the winding of armatures, dynamo construction, and general wiring; practical instruction in the running of trolley cars, and knowledge of distribution of power and arrangement of plant of a city system; locomotive engines, their construction and detail; torpedo practice and planting of mine fields under the supervision of experts; the army and navy codes of signals; the Morse telegraph and the installation of field telegraph and telephone lines, and instruction in infantry and artillery tactics. In its entirety, this is an excellent opportunity for young men to gain, not superficial knowledge, but actual experience in all the above interesting subjects, and solely at the expense of personal time and application. The officers of the battalion are desirous of getting together a congenial group of men, who, by working with the harmony that characterizes a perfect engine, may make for themselves a name in the service, and add greatly to the efficiency of a part of a military system that is growing steadily in favor. The officers of the Battalion of the East held a meeting on board the U. S. S. "Portsmouth," foot of Fourteenth Street, Hoboken, N. J., on Monday, Jan. 20, at 8 p. m., when 35 signatures were obtained.

Billig und Schlecht.

A German manufacturer of incandescent lamps advertises lamps of the normal voltage, in lots of 250, at 14 cents each.

Dark Light Photography.

BY C. J. REED.

The results recently alleged to have been obtained by Prof. Röntgen in photographing without light, instead of being received with surprise, should have been predicted long ago as likely to follow, from certain physical facts that are well established. It is entirely unnecessary to invent or assume the existence of any new or "strange medium" in order to explain such results.

The phenomena of vision are purely physiological, while those of photography are purely chemical. There is no necessary connection between the two. The relation of vision to visible photography is purely accidental.

The organs of vision in man are capable of producing in the brain the sensation of vision only when acted upon by etherial waves whose lengths are between .00036 mm and .00081 mm. This is undoubtedly due to the fact that the substances composing the humors of the eye are easily penetrated by these waves. All waves longer or shorter than these do not give rise to any sensation.

Glass, air, water and other so-called transparent substances have a similar quality of transmitting waves of about the same range in length. When such substances are interposed between the eye and a source of etherial waves ranging between .00036 mm and .00081 mm in length the waves are practically unobstructed and pass through to the eye. It is this accidental circumstance that enables us to distinguish between substances that are transparent and those that are opaque.

The range of human vision, and, consequently the range of ordinary transparency, is a very narrow one, being limited to little more than a single octave of wave lengths as given above. We have good reason to believe, however, that the range of vision in certain lower animals is entirely different from that of human vision. The fact that certain animals, particularly insects, are more active in darkness and have visual organs of an entirely different structure from those of man, shows that their visual range is probably much greater. Waves which we recognize only as heat, in all probability produce in such animals a sensation of light.

Photography depends not at all upon any physiological phenomenon, but altogether upon the fact that certain chemical reactions take place under the influence of etherial waves of a particular range of lengths.

The discovery of photography, but not photography itself, did depend upon the accidental circumstance that iodide of silver undergoes a rapid chemical change when acted upon by etherial waves of a range including and extending beyond that of physiological sensibility. Had these chemical changes been produced only by waves having a range of lengths entirely outside of the visual range, it is not likely that Daguerre would have been able to handle or investigate the waves capable of producing these reactions, even if he had known of their existence. He would in that case never have been able to discover photography.

The first step toward the discovery of photography was the knowledge that visual light caused a chemical change in iodide of silver. The second step was to fix in permanent position the portion of the substance changed by the light, while the unchanged portion was removed.

From what is known of the chemical elements and their compounds it seems highly probable that numerous compounds may exist which are sensitive in the same way to waves of entirely different lengths from those that produce vision. Even with the salts of silver it has long been known that the range of wave lengths capable of producing photographic effect is much greater than the visual range; and that the wave lengths which produce the maximum physiological effect (light) are not the same as those that produce the maximum photographic effect.

It has been shown by Prof. S. R. Langley that flint glass is transparent to waves about four times as long as the longest in the visual range; and that rock salt is transparent to a range below the red end of the visible spectrum 29 times as long as the entire visual range. Glass is opaque to very short waves, its limit in that direction being nearly coincident with the visual limit. Quartz, on the other hand, is transparent to a range of short waves extending far beyond the visual limit, but is opaque to very short waves. May not these substances prove valuable in this new field of actinography, as quartz trains have proved in photographing the ultra-violet spectre?

The reported discovery by Prof. Röntgen of a method of photographing by waves of a range to which glass and the human eye are perfectly opaque, and to which metals and human flesh are transparent—waves which he has been able to produce by means of an induction coil—is not only reasonable, but capable of an easy explanation without the creation of new mediums. The living tissues of the jelly fish are transparent to waves in the range of human vision, and it is not unlikely that ordinary animal tissues are transparent to waves of some other length.

The problem of photographing the bones in a living hand is that of finding a substance that will undergo a permanent chemical change only under the influence of etherial waves of such a length that flesh is transparent to them, while bone is opaque, and of finding an apparatus capable of handling these waves.

Should the reports of this discovery be confirmed we cannot fail to accord the highest praise to this new triumph of science, and to predict a development of the new field of actinography that may prove of greater importance than photography.

From the analogy between this form of radiant energy and dark heat it might appropriately be called *dark light*.

Acetylene Gas.

The New York *World* of Jan. 26, contains an account of the "wonders of acetylene gas" extending over a page, and presenting the subject apparently from the standpoint of the promoters of the patent. It is claimed in the article that acetylene may be distributed either by the already existing system of complex and costly mains and service pipes, or in cylinders, which is declared a far more simple and satisfactory method, and also that it may be used as fuel gas. The gas may be supplied in cylinders such as are employed by physicians for oxygen; a cylinder 8 by 45 inches will contain enough gas to light an ordinary 10 by 13 room dwelling in the longitude of New York for three winter months, while a steel cylinder 8 inches in diameter, and 80 inches long will hold 69 pounds of acetylene and produce an equivalent of 30,000 of ordinary illuminating gas of 24 candle-power. Small cylinders 4 inches in diameter and 7 inches long, fitting ordinary table lamp-stands in place of the usual oil reservoirs, may be served to houses and will produce an equivalent of three ordinary gas burners for 30 hours. Twelve of these would last a person burning the gas five hours a night for three months. It is stated that its application is now under way for household purposes, and also for bicycle and carriage lamps, locomotive headlights, signaling buoys, etc.

It is claimed that for lighting small towns or villages or distant or sparsely settled suburbs, acetylene offers opportunities hitherto unpresented. In Philadelphia there are, for example, 10,400 gasoline lamps, costing $21 per lamp per year; a small cylinder of acetylene could be substituted, which would cost only $7 per lamp per year, and only need to be replaced every two months, and would give two and one half times the present light. It is calculated that the city of Philadelphia would save $114,000 a year by replacing the gasoline with acetylene, the saving being based upon $10 per lamp per year for acetylene. Acetylene gas is also recommended for power, burning either direct in gas-engines or under steam-boilers on launches and small vessels. The propulsion of street cars by means of small motors driven by acetylene in a cylinder under the car floor is another use referred to.

As to the chemical uses of acetylene, passing it through an iron tube heated to dull redness transforms it into benzine, which in turn can be made into nitro-benzine and finally into aniline. The gas can also be made to form carbolic acid and alcohol.

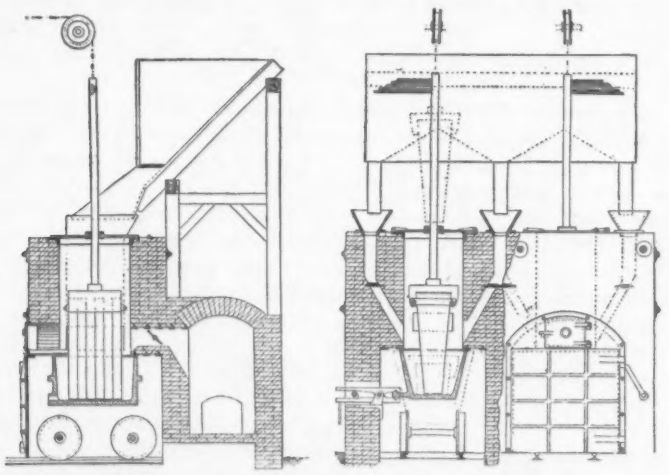
It is claimed that acetylene gas will not necessarily ruin the electric light companies, as their works can be transformed so as to make calcic carbide.

The plant now being erected at Niagara Falls for the manufacture of calcic carbide is of brick, 80 by 90 feet at the foundations and two stories in front and one in the rear. The building will contain a crushing and grinding room in which the coke and lime are crushed, ground and mixed; an electric furnace room; a laboratory for experimental purposes and tests; a switchboard room; and a transformer room, in which the receiving voltage of 2200 will be reduced to 100. In the crushing and grinding room there will be power and machinery enough to handle 100 tons of calcic carbide at 24 hours per day, although the plant at the start will consume but five tons. The machinery will be driven by a 75-hp two-phase motor. In the furnace room there are four furnaces, each containing cast-iron crucibles 3½ feet long, 32 inches deep and 26 inches wide. But one furnace will be operated at a time, the run taking about three hours, and producing 1250 pounds of carbide. Alternating currents will be used,

and the installation of the electrical equipment was commenced on Jan. 7th by the General Electric Company. The statement is made that the power capacity of the present Niagara tunnel would enable an amount of acetylene gas to be produced equivalent to four times that of all the coal gas now consumed throughout the United States.

The new furnaces at Niagara are not described, but the following is the description of the ones used at Spray, N. C. There are two furnaces at that place, of fire brick, rectangular in plan, with arched top and segmental cast-iron hinged doors. Each of the furnace compartments has a four-inch flue for the escape of carbonic-acid gas and steam formed in the process. The bottom of the furnaces has each a cast-iron plate two inches thick protected from the intense heat of the voltaic arc by a layer of dense carbon twelve inches thick, the iron plate forming one of the electrodes. The other electrode in each furnace is built up of six carbon bars or slabs, side by side, each 36 by 4 inches, and forming a pencil 36 inches long, 12 inches wide and 8 inches thick, thus having 96 inches cross-section. The interstices between the prisms of the pencil are rammed with powdered coke and coal tar and baked so as to secure complete electric continuity. The pencil is held in a clamp at the lower end of an iron bar about 4 by 4 inches in cross-section, which has vertical motion through a hole in the top of the furnace and forms the other electrode; it is suspended by a chain passing over a pulley, and may be raised or lowered by a screw or hand-wheel to regulate the distance between the carbon-covered plate and the lower end of the pencil. The upper carbon is protected in a measure from the oxidizing effect of the air by a sheet-iron jacket.

The pencil being lowered so as to touch the bottom of the furnace, the lower section of which each furnace door is composed being closed, the mixture of crushed coke and powered lime is shoveled into the space between the pencil and the walls as high as the top of the door. Being before its conversion an excellent non-conductor of heat and electricity, it protects the furnace walls from the intense heat of the voltaic arc, while not permitting lateral flow of the current. The carbide contained, on the contrary, being quite a good conductor of electricity when hot, serves to maintain electric connection between the upper and lower electrode as the former is gradually raised, owing to the formation by building up from above of an approximately cylindrical mass of carbide after the current is turned on.



1000-HP Carbide Electric Furnace at Niagara.

The theoretically correct proportions of coke and lime would be 64.1 of coke and 100 of lime, but in practice the proportion of coke is increased by reason of its containing mineral impurities and 2 per cent. of water, and that of the lime is somewhat reduced, although it contains about 7 per cent. of water. The coke is pulverized, the lime slowly air-slacked, and then the proper proportions are weighed out and the materials incorporated and thoroughly mixed. The mixture is fed in from in front, as before stated, the pencil resting on the slab of the furnace bottom, about 1000 pounds being needed for the first charge.

The current is then turned on, the arc being established between the pencil and the furnace bottom by slowly raising the former. The heat fuses the immediately surrounding mixture, and causes chemical combination, the resultant carbide forming on the furnace floors just under the pencil. The latter is slowly raised, so as to keep the carbide cone, which takes up the space which the electrode of the pencil leaves, constantly forming. The regulation of the position of the pencil is in accordance with the indications of a voltmeter.

At the end of the run, which takes from three to five hours, the current is stopped and the furnace allowed to cool for about an hour, after which its contents are removed. These consist first of an approximately cylindrical mass of carbide occupying the space in the coke and lime mixture left by the withdrawing of the pencil, and second, of the surrounding uncombined coke and lime, these, however, being by this time thoroughly freed from moisture, and suitable to be charged again as raw material.

In a report made on the process as carried out at Spray, it was stated that the current employed was 2000 amperes at 65 volts, and that there was a drop of 7½ volts between the electrodes. The electrode loses about one inch, or 172 pounds, in 11 runs or charges, so that each carbon is available for making 21 tons of carbide. The furnace is stocked from time to time, as the gases formed at the arc make channels through the raw material, particularly if unslacked lime is used, and this channelling prevents new material from falling into the arc. When the current becomes too large, the attendant raises the pencil. Should the arc be broken, as shown by stoppage of current, the pencil is quickly lowered. Carbide has been made at Spray with direct current also, but the alternating current completely eliminates all suggestion of electrolysis in the process. The quality of the carbide is best with low voltage. The bottoms of the new furnaces will be formed by a car running on rails and the feeding and stoking will be mechanical. This will give continuous working in each furnace, a car being run out and a fresh car run in. The calcic carbide itself is a hard blackish blue or bluish gray mixture, somewhat crystalline and cokelike in appearance; it is odorless and unchangeable in a dry atmosphere, but when moistened gives out in greater or less quantities acetylene gas, which is slightly garlical in odor, but is stated to be less poisonous than ordinary water gas. It is claimed that one ton of calcic carbide makes 11,000 feet of acetylene gas, capable of supplying 4400 one-quarter foot burners, each of which it is stated gives more light, as a practical illuminant, than 25 standard sperm candles. Elsewhere it is stated that its illuminating power, as compared with Philadelphia gas, is 30 to 1, but practically 40 to 1, owing to the superior light given. Still another statement is made that acetylene gas will give the consumer more and better light than the Welsbach burners at a saving of 20 or 25 per cent., at the same time yielding the manufacturers profits far exceeding the present ones. It is stated that the best results are obtained by an ordinary flat burner consuming 1 cubic foot of acetylene gas per hour and giving an equivalent of about 6 ordinary 18 candle-power gas burners.

The following is given as the cost of manufacture of one pound of calcic carbide:

Lime, 2000 lb	$4.00
Coke, 1500 lb, at $3 per ton	2.25
Labor	5.50
Interest, 6 per cent. on $10,000	2.00
Carbons	.50
Power at $10 per hp per annum	5.47
Incidentals, taxes, insurance, etc.	1.00
Total	$20.72

On Jan. 22 Prof. Crafts, of the Massachusetts Institute of Technology, read a paper on acetylene gas before the Boston Society of Arts. He stated that under the best conditions acetylene is eight times better than the gas now used. Referring to distribution he said that pipes of better quality than we now have must be used for acetylene gas, it being necessary to solder the joints, as leakage is dangerous. It is proposed to store the new gas, in a liquid form, in steel cylinders under a pressure of from 600 to 700 pounds to the square inch. Three or 4 per cent. of acetylene gas will, he said, form a mixture of terrible explosive force, and, therefore, the use of many of these cylinders in office buildings is not to be commended. Acetylene gas, he added, is more explosive than common gas. A room, 20 per cent. of whose contents is acetylene gas, would be blown to pieces, along with the house. Equal parts of acetylene gas and oxygen, to the total weight of five grains, makes a tremendous explosion, much greater than from the same weight of gunpowder.

The London *Electrician*, of Jan. 17, refers to the statement of Dr. A. Frank, of Charlottenburg, Germany, that calcic carbide would be a cheap and convenient method for the transmission of energy, the primary source of energy being a waterfall. He concludes that to obtain 1000 hp for 25 days would require 295 tons of calcic carbide as against 413 tons of coal. Commenting upon this, the *Electrician* says that the comparison is woefully incomplete, not only through the absence of the comparison of cost, but otherwise. It adds that nature has provided us with a richer fuel than even calcic carbide in ordinary petroleum, and that 267 tons of coal for gas to be used in gas engines and about 274 tons of petroleum for oil engines would be a dynamical equivalent for the 295 tons of calcic carbide.

Central-Station Working—V.

ARC LIGHTING STATIONS.

BY A. N. RATHBUN.

IN discussions on central stations the arc plant, though the pioneer in electric lighting, usually receives scant notice. The arc dynamo, with its series-winding and distribution, its enormously high potential and its radically different regulation, often presents practical difficulties which only previous experience and knowledge can surmount. Even to designers the arc machine has been somewhat of a mystery, both in its operation and in the fact that in a successful arc machine almost all of the usual rules of good dynamo design are apparently violated. Perhaps, in view of these facts, a few suggestions on the operation of arc lighting stations may be timely.

There are two great classes of arc dynamos, the open and the closed coil machines; both are largely used, and while some of the hints herein given will be of general application, there will also be some that will only relate to one or the other class.

Among the problems that confront the arc light station manager is how many dynamos can be run in series. As towns grow larger and larger, a single block may take a full complement of 60 commercial lamps and thus require the services of one machine, and, if not in connection with other machines, a separate circuit as well. If the line be at all long the copper involved will be too expensive to be allowed to lie idle and yet unless two or more machines in series are used when the block in question is lighted, it will be impossible to avoid this. The problem is therefore a pertinent one.

It will be found that two or more arc machines will work perfectly well in series by connecting + to — on each machine, thus leaving a + and a — for the line. But as the potential thus obtained is the sum of the potentials of the several machines, the limiting factor is not found in the station but in the insulation resistance of the lines. Two of the favorite 60-light units will involve 6000 volts, which voltage presents no difficulties, and 120-light units have in consequence been recently put on the market by several manufacturers. Three 3000-volt units in series involve a potential that for successful working calls for the best rubber wire and oil insulators, while four produces a voltage higher than any at which power has been successfully transmitted. Therefore, the inference would be that with present line construction for arc work, 6000 volts or two units is the limiting load that may safely be allowed on any circuit.

Open coil machines have commutators of few segments. The profuse sparking that always occurs in normal operation is not a serious matter on account of the small quantity of current transmitted. The two great representatives of this class—the Brush and the Thomson-Houston machines—different as they may appear in their outward construction, have very similar electrical connections and produce very similar phenomena as regards sparking at the commutator. This action is very curious. The machine is started, and, having attained speed, the brushes are drawn considerably back of the neutral point, and the switch, short-circuiting either the field or armature, as the case may be, is opened. The machine builds up, of which evidence is given at the commutator by a spark nearly 1¼ inches long. The current, however, is very slight. The brushes are slowly rocked forward to the neutral point and the current rises, the spark shortening before the advancing brush. When the spark reaches a length of 3-32 of an inch the machine is allowed to run that way for a reason presently to be discussed.

If at this point the current has not attained full value and the field is not shunted by regulators or the machine otherwise limited by control, the popular supposition has been that the only way to get the full current is to increase the speed. If we rock the brushes still further forward, the spark seems to disappear under the brush and the neutral point is attained. If, however, the brushes be rocked still further forward, or the load or the speed diminishes, a furious flashing occurs between the brushes which completely throws the load off the machine. Therefore, to allow a margin, a normal spark of 3-32 of an inch is allowed in continuous running. Fig. 1 shows the various points on an open-coil commutator. When the current refuses to attain its full value at normal spark with all regulating devices relaxed, the machine is overloaded. This may be a genuine overload, or it may be that some defect exists in the machine, and this latter is surely the case if the machine has previously carried the same load. Short-circuited field or armature coils may be the cause of the difficulty. These may be found by appropriate measurements. When the construction of the machine will readily permit, the defect may be located in the field or armature by trying a suspected armature in the field of a machine known to be intact, or by trying a perfect armature in the suspected field.

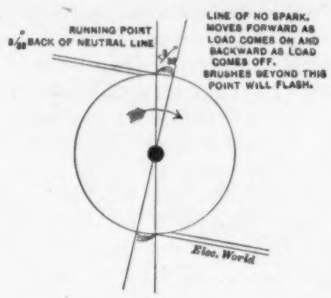

RUNNING POINT
3/32 BACK OF NEUTRAL LINE
LINE OF NO SPARK. MOVES FORWARD AS LOAD COMES ON AND BACKWARD AS LOAD COMES OFF.
BRUSHES BEYOND THIS POINT WILL FLASH.
Elec. World

FIG. 1.

Short-circuited windings are hard to detect and only careful resistance measurements will detect them.

The writer has found that with open-coil armatures the brown gloss, which is such a desideratum on the commutators of closed-coil incandescent machines, is a source of serious loss of output in open-coil machines. He has repeatedly noted that after a machine had been in service some time and its commutator became glazed, the output fell off one or two lamps. In one instance, a 30-light dynamo, running at its normal speed, would flash before the current could be brought up to its normal value with 30 lights in circuit and all controlling devices cut out. Not until the load was reduced to 28 lamps could full current be attained. A thorough test of the windings failed to disclose any trouble. While in the midst of the mystery, some new commutator segments that were to be put on arrived, and the old glazed segments were taken off. As soon as this was done the full complement of lamps could be lighted with ease, and it was afterward found that a similar complaint in a machine could always be cured by sand-papering the commutator. The added resistance of the dirty commutator was a serious matter, even with such high voltages. The missing energy is not dissipated at the commutator in heat, but the resistance of the contact prevents its generation. This fault belongs to open-coil machines only.

A series-arc machine has one very annoying feature, the residual field being frequently reversed, which causes the current to be generated in the reverse direction, and, therefore, all lamps in circuit with it burn upside down. To restore the reversed machine, it should be stopped, its armature short-circuited and connected in series with one of the operating machines, care being taken to have the current flow in at the negative binding post and out at the positive, precisely as it would if the machine were generating current. After a few minutes the machine may be removed from circuit and started up, when it will be found to give out its current in the proper direction.

An arc machine should be frequently tested for grounds. The insulation of a machine depends upon the instantaneous maximum voltage. In a test on a 1500-volt open-coil arc machine, the instantaneous maximum was found to be considerably over 6000 volts, and that is what the insulation has to withstand. Therefore, on arc machines, especially of the open-coil type, the danger of puncturing the insulation is most serious. To test for a ground, one end of a flexible cable should be pressed against the framework, and first one brush and then the other connected with the free end, looking carefully for arcs. Static sparks may occur, but they may be readily distinguished from the little arc produced by a feeble ground. If the arcs are found, the safest way is to make firm contact between a brush and frame, until the ground becomes more pronounced, when it will indicate its whereabouts by a dart of flame on the magnets or armature, and can thus be detected and repaired.

Static discharges are apt to provoke grounds and are very frequent on high-voltage machines. A condenser consists of two conductors separated by a dielectric. In the case of an arc dynamo, the copper winding constitutes one conductor and the frame the other, the dielectric being the insulation of the machine. This forms a condenser of considerable capacity, and if two wires are brought within striking distance of each other and connected to the iron frame and one of the binding posts of the machine, the snapping static sparks that

follow will give evidence that this condenser is thoroughly and continuously charged. Imagine this continuous static discharge taking place across some weak spot in the insulation, and it will be easy to see how a substantial arc may in time be established. To avoid the puncturing of the insulation of the machine through this cause, the writer has found it convenient to provide a legitimate path for the discharge by connecting the frame and copper circuit with a vacuum tube. This allows the static discharge to pass, but is a barrier against the normal voltage of the machine.

An open coil arc dynamo should never be shut down without first short-circuiting either its field or armature. A switch is usually provided for this purpose. This is a caution that one experience will render unnecessary, but one unfamiliar with this type of machine may save severe damage to his commutator by previous knowledge. As the speed of the machine falls the commutator begins to flash, and even when making the last few revolutions long vicious arcs are still present. Unless the field or armature is short-circuited, as directed, the commutator may be severely burned.

An arc machine will seldom burn out from excessive current in its windings. A good one should readily endure short-circuiting with impunity, and a mere adjustment of the brushes should bring the current to its normal value. In some machines this is done by hand, but it is often automatically accomplished. This automatic action causes the current in the main line to be continually fluctuating through a small range, which is an advantage rather than otherwise, for such a current tends to keep the lamp mechanism from sticking. The thing to be dreaded is rather a failure of insulation. It is better for the machine to place it upon an entirely insulated foundation, the resistance of which should be at least 500,000 ohms. As regards the safety of those who have to do with the machine, it is better to have the machine thoroughly grounded, thus avoiding the differences of potential between the frame and the ground that are likely to occur. In arc stations the wiring is frequently so poorly done that the insulation of the machine is in jeopardy if the frame be securely grounded. Therefore, the writer advocates the American practice of insulating the dynamo from the ground. A man can be careful to avoid accidents, where a machine is helpless. Rubber matting should be spread on the floor all around the machine, or a glass floor put down, and the brushes manipulated with one hand.

Grounds on an arc current are most readily detected. By its series construction the line is divided into definite sections of about 50 volts each and the grounds occur generally between these sections on the line connecting the lamps. The following method, which rests upon the principle of the Wheatstone bridge, is very convenient: An arc circuit is represented by *G G*, Fig. 2, and at its ter-

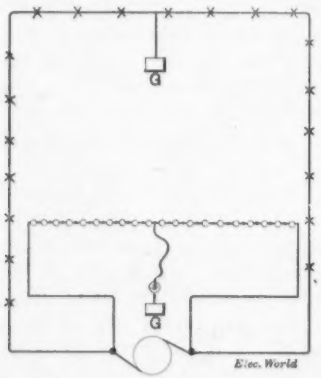


FIG. 2.

minals is shunted a circuit of 50-volt, 8-candle-power incandescent lamps. These lamps consume one half of an ampere and are only connected thus for the purpose of testing. The number of incandescent lamps is equal to the number of arc lights. Now suppose that between the 9th and 10th lamp the current became grounded. The fall of potential from the positive terminal to the ground is 9 x 50 or 450 volts, and the fall of potential from the positive terminal to the wire between the ninth and tenth lamp is also 450 volts. Hence, if these two points are connected, no current will flow. By simply grounding the terminal of some indicating device, as a voltmeter, and touching the free terminal to the terminals of the incandescent lamps in succession, one will be found where the current is a minimum, and between the corresponding lamps on the line the ground exists. Thus the fault can be accurately located, and a lineman sent out to correct it.

Central-Station Working—VI.

CENTRAL-STATION DATA.

BY H. W. FRUND.

The National Electric Light Association, through its Committee on Data, from time to time in the past have petitioned central-station managers for their reports, the information petitioned to be used by the committee in making a strictly engineering report of the mechanical efficiency of the various types of equipments in use in central stations. That the information thus received is of great value to every central-station company and eagerly sought for, no one will gainsay. It is, however, a painful fact out of 2344 stations in operation in the United States, the report of the last Committee on Data at the Cleveland meeting on Feb. 21, 1895, only covered 24 from central stations. The question of the reports being held strictly confidential cuts no figure with a central-station man, as they are anxious to ascertain this class of information. The facts are, it is not generally understood that but very few stations keep a record from which reports can be satisfactorily made; this being given as the main reason why these data have not been forthcoming. It would seem in point for the committee in their communications to instruct parties in charge of plants how to make these reports, which would be gladly received and which would also be beneficial to the committee seeking this information.

The question of central-station data is one that interests every one very much. It is only by comparison that one is enabled to determine the comparative values of different methods or commodities. The number of watts produced per pound of coal, the average number of pounds of water evaporated for one cent expended in fuel, no other expense being taken into consideration, and similar information are interesting items for central-station men. From reports thus far made, coal and water represent almost one third of the entire cost of developing energy at central stations, when situated at a distance from the coal supply. If this is the case, it is of great importance to know the best kind of coal to purchase. Price of coal is no sure indication of its value as a water evaporator. One grade of coal will prove, in a plant of ample boiler capacity, to be excellent and derive good results, while the reverse may be the case with the same coal in an adjoining plant with skilled workmen, but where it is necessary to crowd boilers for lack of capacity. Where complete reports are made, the manager does not have to depend alone upon the statement of the engineer or fireman as to whether the coal being used or some other coal is best suited for his purpose. To show the fallacy of this, suppose an engineer or fireman submits reports on light-load operation, showing an extravagant amount of coal used in comparison with water evaporated. Upon investigation it may be found that in a battery of three boilers, the work at one period of the run could have been done efficiently with two boilers and later with one boiler, but instead the same number of boilers required for heavy load were left on during light load, and further that the dampers were not properly manipulated on light loads. By thus failing to work the dampers properly and not cutting out unnecessary boiler capacity, the expense for fuel would, of course, be made much higher than necessary. This is only part of the information that central-station managers procure from reliably kept records.

As many persons in charge of central stations are unacquainted with methods of testing, it would not be amiss to illustrate one simple way of ascertaining the cost of coal from different mines by ascertaining the cost of evaporating one pound of water. A water meter, hot-water thermometer and scales are all that is required, the expense of which can often be paid out of the savings resulting from one test, and in addition there is the satisfaction of knowing the true working of the plant.

As an example, in a certain test 748 cubic feet of water were used, weighing 44,850 pounds. This is with water at 206°, which weighs 59.96 pounds per cubic foot (see Roper's Handy Book, page 520). The net coal used (slack, costing 60 cents per ton of 2000 pounds). was 7845 pounds, so that 5.71 pounds of water was evaporated by one pound of coal. Now, as there were 7845 pounds of coal consumed, costing .03 cent per pound, the total cost was $2.35. Dividing this by 44,850 we have the cost of evaporating one pound of water.

This method is a very simple one, and enables every central-station man to furnish the Committee on Data with a report that will supply reliable figures for comparison and for mutual use and benefit. In view of the fact that the next annual meeting of the

National Electric Light Association takes place in New York in May, no time should be lost in complying with the request of the committee.

The Form Factor of Alternating-Current Curves.*

BY J. A. FLEMING, D.SC., F.R.S.

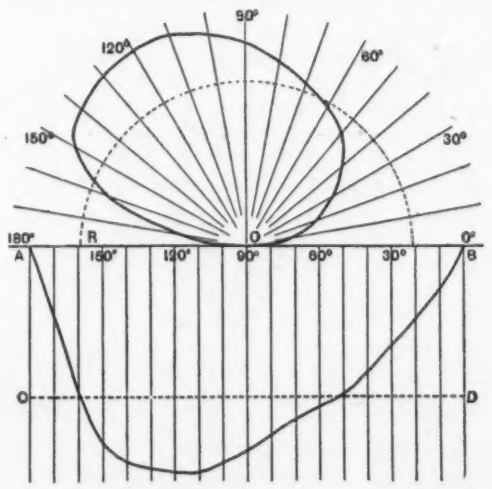
In the design of alternators, as well as in the discussion of some transformer problems, we have frequently to consider the relation between the true mean (T.M.) value and the square root of mean-square (R.M.S.) value of the equi-spaced ordinates of a single-valued curve representing a periodic current or E. M. F. It is convenient to have a simple term to express this ratio. I venture to suggest the term *form factor* for it. This quantity has been already recognized and symbolized in various alternating-current investigations by Mr. Kapp, Dr. Roessler and others, who have pointed out its significance. If f stands for the form factor of any periodic curve, then $f = \frac{\text{R.M.S. value}}{\text{T.M. value}}$ of the ordinates of a semi-wave taken at equi-distant intervals along the time-axis. If y is the ordinate of the curve and x is the half-wave length, then $f = \frac{\frac{1}{x}\int_0^x y^2 dx}{\frac{1}{x}\int_0^x y\,dx}$. Geometrically it can be obtained as follows:

On any horizontal line draw a wave diagram to represent the half-wave of a periodic curve of E. M. F. or current, and with any point on this line as a polar centre draw a polar diagram to represent the same curve. With the planimeter find the areas of each of these curves, and find the rectangle equal in area to the wave curve and the semi-circle equal in area to the polar curve. Then the ratio of radius $O\ R$ of the semicircle to the altitude $B\ D$ of the rectangle is the form factor for the curve considered. For it has been shown that the radius of the semi-circle represents the R. M. S. value of the ordinates of the curve, and the altitude of the rectangle represents the T. M. value of the same.

The form factors for certain curves are given below:

Curve.	T.M. value of ordinate as fraction of max. ordinate.	R.M.S. value of ordinate as fraction of max. ordinate.	Form factor *f*.
Sine	0.637	0.707	1.1
Semicircle	0.7854	0.835	1.063
Triangle	0.5	0.58	1.16
Rectangle	1.0	1.0	1.0
Semi-ellipse	0.785	0 816	1.039
Parabola with axis vertical.	0.666	0.730	1.096
Two semi-parabolas meeting at a cusp	0.33	0.447	1.35

The more peaked the curve the larger the form factor. If one dared to disregard proprieties of language the form factor might otherwise be called the "coefficient of peakiness" of the curve.



METHOD OF DETERMINING FORM FACTOR.

It is now well understood that the core loss in a transformer depends upon the form factor of the curve of primary E. M. F., and that an increase of form factor causes a diminution of core loss due to hysteresis. It has not yet been entirely demonstrated that curves of E. M. F. of different shape but equal form factor will give equal hysteresis loss, but it is very probable such would be the case. Under these circumstances a specification for transformers is incomplete unless it is stated that the test of core-loss shall be made on an alternator with a curve of E. M. F. having a given form factor. The form factor of the curve of E. M. F. of an alternator may change considerably as the character of the load whether inductive or non-inductive is altered, if the alternator is one having a large armature reaction.

* From the London *Electrician*, Jan. 10, 1896.

Acetylene Gas.

In a paper read by Mr. John C. McMynn, at the recent Milwaukee meeting of the Northwestern Electrical Association, some facts were given concerning acetylene gas. In a recent visit to Spray, N. C., Mr. McMynn inspected the original plant of Mr. T. L. Wilson for the production of calcium carbide. This consists of a very primitive electric furnace, the current of which is furnished by two 120-kw alternators, the voltage of which is transformed down to about 100. The carbons are 12 by 8 inches and 36 inches long, and convey a current when the furnace is in operation at from 1300 to 1400 amperes. A bed of finely powdered coke and crushed lime is placed between the carbons, and being fused by the intense heat, calcium carbide is formed.

Mr. McMynn believes that the new gas will be a rival of electricity, and advises the members of the association to decide as to its value as a competitor, not only of the incandescent but of arc lighting. He states that he saw two tons of calcium carbide produced in two days at a cost of about $25 per ton, and samples of this carbide produced an average of 5.13 cubic feet of acetylene gas per pound of carbide. Acetylene gas, he says, will produce about 50 candle-power per cubic foot per hour, but the flame, having no blue light near the burner, seems to give much more than this amount of light, because of the spectrum being more identical with the sun. One half a cubic foot of acetylene gas, he says, will give more light than four cubic feet of common gas, and can be produced at a maximum figure of $3 per 1000 cubic feet. As to the manner of using the gas, the best method is not to distribute it through mains, on account of leakage, but by means of a small automatic generator for each house, holding a week's supply. A house having 20 burners would probably use 10 for four hours per day, and with one-half cubic foot tips would consume 140 cubic feet of gas per week, or about 28 pounds of calcium carbide, at a cost of three cents per pound, giving a gas bill of $3.36 per month, and illuminating the house much more brilliantly than could be done in any other way, except by a large number of incandescent lights. The gas, Mr. McMynn says, may be liquefied, and in this form distributed in cylinders similar to carbonic-acid gas cylinders, and, being admitted to the house mains by pressure-reducing valves, it will assume all its gaseous qualities.

Mr. McMynn sums up by pointing out the advantages gas companies will have if they obtain the rights for the use of this gas, which will, he informs them, give them a weapon much stronger than the Welsbach burner, while the electrical generating machinery necessary for producing the gas can part of the time be used in direct competition with present electric lighting plants. He considers that the field opened up by acetylene is wonderful in its possibilities for successful investments and large business, and draws the attention of the members of the association to the fact that as their electrical generating machinery is idle at least half of the time, if they added the manufacture of acetylene gas, their plants could be worked full power and a territory exploited that cannot be reached by either gas or electric lighting.

Mr. McMynn calculated that allowing a maximum cost of $50 per ton for carbide delivered either as a liquid or as a gas, ten 16-candle-power lights from acetylene will cost 1.6 cents per hour, as compared with 6 cents for incandescent lighting and 7 cents for gas.

A Profitable Transaction.

It is reported that the Philadelphia syndicate which sold the Meriden, Conn., electric railway to the Consolidated Railway Company made a profit of $197,000 on the transaction; 9850 shares were sold at $20 per share, and the purchasing company assumed a floating debt of $70,000, and purchased a first mortgage of $101,000, making the entire expenditure in order to get hold of the property $368,000.

On the Photometry of Differently Colored Lights and the "Flicker" Photometer.*

BY FRANK P. WHITMAN.

In November, 1893, during measurements on some colored discs, it became necessary to know the relative luminosities of the colored papers employed. An attempt was first made to estimate the luminosity directly by comparison with Maxwell discs of black and white, smaller in diameter, and mounted on the same axis. The relative proportions of black and white were changed until, on rotation, they formed a gray, which was estimated to be about equal in brightness to the colored disc under examination. This method, practiced by certain experienced observers, doubtless has afforded good results, but in my hands proved difficult and uncertain.

Trials were then made by four other observers, all somewhat skilled in physical measurement, whose general color-sense was found to be similar, but their estimates of luminosity were found to vary in such an irregular fashion as to make any comparison impossible.

Later experiments, carried out with the help of some 30 undergraduate students, led to similar results. Differences of 50 per cent. between two different observers frequently arose, when the light to be compared differed no more than an ordinary from a Welsbach gas-burner; while the same observers, working with light of the same color, would agree at least within 2 or 3 per cent.

By practice the margins of difference may be rendered smaller, yet experts often differ in their estimates of the brightness of arc lights when compared with standards of different color; and it is questionable whether one can always be sure that by practice in such measurements he gains greatly in accuracy. His measurements agree with each other better than at first, but if his method of comparison have in it something of an arbitrary or personal quality, as it must from the very nature of the case, it remains uncertain whether he may not be fixing himself in an erroneous practice rather than approaching a correct one.

The character of these results, and the need of some more exact method of comparing color-luminosities, led to the consideration of Prof. Rood's "flicker" experiments.

Rood prepared about 50 gray discs differing successively, as equally as possible, in depth of tint from black to white. If a dark shade was combined with a light shade in the usual way, and rotated rather slowly, the familiar unpleasant sensation known as a flicker was produced; but if successive pairs, more and more nearly alike, were chosen, the flicker became less, until it almost or quite disappeared. Nearly the same effect was produced if, instead of a gray, some other color was substituted on one of the discs. It was always possible to combine with it a gray disc of such a shade that the flicker nearly ceased, showing that this sensation is apparently independent of the wave-lengths of the lights compared, and dependent only on their relative luminosities. Prof. Rood suggests that the principle may be easily applied to ordinary photometric work, but indicates no method. The special arrangement described in his paper serves admirably to compare pigments, when in such form that they can be spread upon discs and mounted in the whirling machine.

For ordinary photometric purposes, however, there is necessary some arrangement by which luminosity can be varied continuously instead of step by step, as with a set of gray discs, which can be mounted on a photometer bar so as to compare colored lights as well as colored pigments, and which is reasonably quick and convenient in use. No doubt there are many ways of applying Prof. Rood's flicker principle; the one which I, after some trial, found most successful was as follows:

A card was cut in the shape *AHBG*, in the figure, so as to form two semicircles of about 5 and 8 cm radius respectively, joined along a common diameter. This could be rotated at any desired speed about the axis *K*, in earlier experiments by clockwork, but afterward, and more conveniently, by hand. A diagrammatic plan of the apparatus as used is shown in the figure. *DE* represents the photometer bar, *AB* is the revolving disc, *C* is a card, which may be white or colored with any pigment which it is desired to study, *F* is a tube through which the observer looks. It is evident that when the apparatus is in the position shown in the figure, the outer portion of the revolving disc only will be visible through the tube, but when the disc is rotated half a turn, the small semicircle will not come into view at all, and the observer will see only the card *C*. As the disc revolves, the two pieces will be presented to the eye in rapid succession, and, if they differ in luminosity, will produce the sensation of "flicker." If equal lights are placed at the ends of the photometer bar, the relative illumination of the card and disc can be varied by sliding the photometer along the bar. The flickering sensation can thus be entirely destroyed, whatever the colors are upon the card and

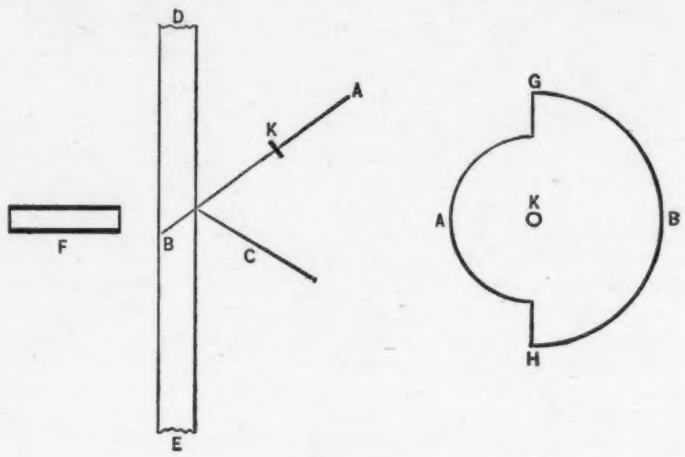


Fig. 1.

disc. (Various colors were tried upon the disc,—red, white, and different grays,—but white was finally adopted as in all cases the most convenient.) When the proper position of the photometer was reached, not only did the flicker vanish, but the sense of color in the field of vision became much weaker or entirely disappeared so that it was frequently difficult or impossible to tell what color was upon the card. A slight movement of the photometer in either direction revived the sense of color and re-established the flicker. The results obtained with this instrument were surprisingly good in ease, rapidity, and precision.

Work was interrupted at this point until May, 1895, when the measurements were taken up again, and the instrument itself somewhat carefully studied.

The colors used for experiments on pigments were chosen from the well-known series of colored papers made by the Milton Bradley Company of Springfield, Mass., and included the whole range of the spectrum. These papers were pasted upon perfectly flat cards, and placed successively in the position marked *C* in the figure.

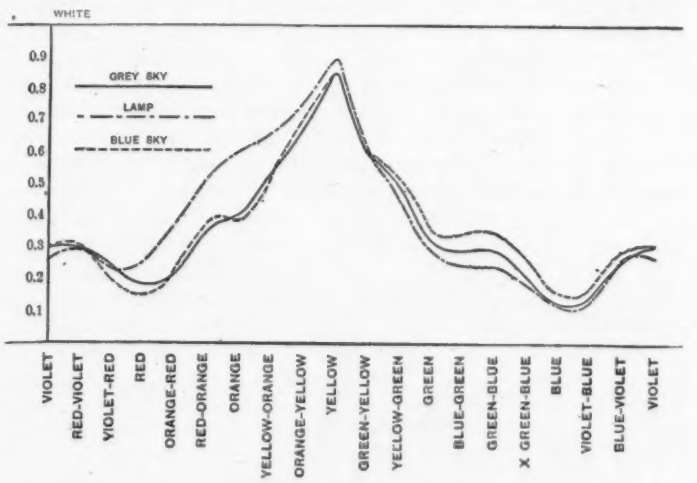


Fig. 2.

Three curves are shown to illustrate the capacity of the instrument, exhibiting the relative luminosities of these 19 colors, when illuminated by the light of a kerosene lamp, of a dull gray sky, and of a bright blue sky.

The predominance of the lamp-curve toward the red end of the spectrum and of the clear sky at the other end is manifest, while the similarity of the curves shows that the measurements are of like character and definiteness, whatever the source of illumination. In all these cases the revolving disc was white, lighted by a lamp, while the colors on the card were exposed to the light under investigation. Since the flicker effect is independent of the wavelength, any source of light which is constant may be used to illuminate the disc without changing the results dependent on the

* From the *Physical Review*.

luminosity of the colored card. The curves from sky light and cloud light, though the mean of several trials, were not entirely satisfactory on account of the comparatively inconstant brightness of these sources of light. These observations on lamp light, however, were made twice, at an interval of over two months, with practically identical results.

A greater interest, perhaps, lies in the instrument itself. An apparatus so new and depending on a physiological principle which has been so little studied, presents many points for investigation, before its utility as a practical photometric apparatus is assured. The remainder of this paper is occupied with a study of some of these points.

1. The precision of setting, as compared with other types of photometer, was tested in over 100 settings on 19 different colors. The difference between two successive readings was seldom more than 1 per cent., though a few readings differed as much as 2 or 3 per cent. As these readings were made over the whole range of the spectrum, it seems fair to say that the instrument can be used upon lights presenting the widest difference of wave-length, with a precision approaching that of ordinary types of photometer when comparing lights of the same color.

2. Since the photometer depends, not on the actual comparison of like quantities, but on the distinctness of a peculiar physiological sensation—the flicker—it is worth while to see whether different observers will agree. To test this question, and incidentally to try the instrument with colored lights instead of colored papers, both disc and card were made white, and equal lamps, the colors of which could be changed at pleasure by the interposition of colored glass, were placed at the ends of the photometer bar. Two observers, whose eyes were known to be similar, compared successively the brightness of the two naked lamps, first by an ordinary photometric method, then by the flicker. A red glass was then placed in front of one lamp, a green glass in front of the other, and the same observations were made again. One of the two observers had never seen the instrument before. The results follow, each being the mean of four or five concordant observations. The actual readings are given in feet and hundredths, not reduced to comparative luminosities. One lamp stood at 3.00, the other at 9.00 on the photometer bar.

Observer F.		Observer W.	
Ordinary.	Flicker.	Ordinary.	Flicker.
Both lights naked.			
5.98	5.96	5.98	5.98
Left lamp red, right green.			
5.59	6.79	6.08	6.88

Thus, in the last case, the setting of F by direct estimation differed from that by flicker by 1.20 feet, that of W by 0.80 foot.

The setting of F by estimation differed from that of W by 0.49 foot; while F's flicker setting differed from W's by only 0.09 foot. The last disagreement is comparable with the errors of observation.

At a later time, three other observers, making comparisons for technical purposes between coal-oil lamps and a standard candle which differed from them somewhat in color, were able with the flicker photometer to obtain accordant results among themselves much more easily and surely than by ordinary methods.

3. Two "discs" like those in the cut were mounted on the same axis in the photometer. By sliding one upon the other, the fraction of a revolution during which the card was visible could be varied between 180° and 0°. The relative length of exposure of the eye to the two lights could thus be varied within wide limits. Several comparisons were made of lights differing widely in color, and with openings from 22½° to 180°, but no differences in reading were observed that could be traced to this cause. While it is true that the sensitiveness of the retina differs for lights of different wave-lengths, and probable that differently colored lights require different periods of time to produce equal sensations in the eye, it appears from these experiments that there is time, at the comparatively slow rate of rotation of the disc, for every color to produce its full effect, so that errors which might be produced by irregularity in rate of rotation or in shape of the disc are negligible.

4. In much of the work the photometer and standard lamp were kept at fixed points, and the balance obtained by moving the other light, thus making all comparisons at the same actual degree of illumination. This method of using any photometer has some obvious advantages, though the sensitiveness is not quite so great as when the photometer itself is moved. To determine whether the absolute brightness has any effect on the settings, measurements were made of six colors—red, orange, yellow, green, blue, violet—under widely differing illuminations. When the light was faint the measurement became much more difficult, but the results obtained with bright and faint light did not appreciably differ, showing that the well-known greater sensitiveness of the eye to blue light is not important in measurements made under conditions proper to this photometer When the illumination is small the flicker is very faint and may be invisible while the photometer is moved over as much as 6 or 8 cm, but by reading the points each side of this space where the flicker again becomes visible, and taking the mean of the two readings, results may be obtained almost as trustworthy as with brighter light. It should be remarked that this method in general depends for its value somewhat on the state of the eye. It appears certain that two normal eyes, in a reasonably fresh condition, would obtain like results, but if the eye is wearied from long-continued observation or loss of sleep, the perception of the flicker becomes more difficult, and the difficulty appears to vary with different colors in a way that has not yet been studied.

5. The question still remains, whether the flicker method gives in all cases a true measure of luminosity comparable to that which would be obtained by any more direct photometric method. To test this, the luminosity measures afforded by Maxwell's discs were used.

Suppose, for example, three colors—say red, green, blue—combined on the whirling machine into a neutral gray, which is matched by the combination of a black and a white disc. The amount of white in the latter combination, corrected for the white light reflected by the black portion, is of course the measure of the luminosity of the colored disc in terms of white, which quantity, again, is dependent upon the luminosities of the three colors of which it is composed.

If now the fraction of the whole circle occupied by any color is multiplied by its luminosity as measured with the flicker photometer, the result will be the amount of white equivalent to that colored sector, and the sum of the results obtained by treating each of the colored sectors in this way should equal the amount of white in the black and white disc. Two examples are given below. The circumference of the disc was divided into 100 equal parts, so that the numbers given are direct percentages of the whole circle.

The upper row of figures in each case is the ordinary color-disc equation. The second is the luminosity of the given colors referred to white, as measured by the flicker, the lower line gives the product in each case. The sum of these products given under white should be the same as the white in the upper row, which is the corrected reading from the black and white Maxwell discs.

	Red.	Green.	Blue.	White.	Red.	Green-Yellow.	Blue.	White.
Color-equation	40.5	49.2	10 3	22.6	18.5	34.0	47.5	30.4
Luminosity	0.238	0.295	0.106	—	0.238	0.617	0 106	—
	9.64	14.50	1.09	25.23	4.41	20.96	5.03	30.40

Fourteen such trials were made with different colors, the results differing by one to three per cent. from exact quality.

Summary.—The flicker photometer used to compare lights of any color approximates in convenience and accuracy any of the ordinary photometric appliances used with lights of the same color. Different observers whose vision is normal obtain like results.

Irregularities in the division of the disc or the rate of rotation are without appreciable effect on the precision of the measurements.

Differences in the absolute brightness of the lights compared present no greater difficulties than in any photometric method.

The instrument gives a true measure of luminosity comparable with that obtained in other trustworthy ways.

The Metric System in Great Britain.

Commenting upon the recommendation of a Parliamentary Committee that the adoption of the metric system of weights and measures be made compulsory two years after the passage of a law to that effect, London *Engineering* says it must be conceded by all that such adoption will be enormously beneficial. The time has gone past, it adds, when it is necessary to furnish arguments as to the advantages of the metric system over present confused methods. Those whose business it is to deal with foreign countries know best how much they lose when they come into competition with manufacturers from Germany and Belgium, from the inability or indisposition of other nations to comprehend British standards. *Engineering* regards it as an absolutely foregone conclusion that the metric system will be adopted here, and the only points open to discussion are how the transition can be made most easily, and how far can advantage be taken of the change to establish certain international standards, which would have great commercial value.

The Milwaukee Convention of the Northwestern Electrical Association.

In our issue of last week the proceedings of the morning of the first day's meeting of the convention of the Northwestern Electrical Association were reported. The paper of Mr. W. J. Buckley, an abstract of which appeared in our columns last week, was read during the afternoon session on Jan. 15, and was followed by a discussion in which Messrs. Summers, Schuette, Grier, Howell, Grimm, Terry and Copeland took part.

Mr. Summers considered it questionable whether a 2½-watt can be used on many alternating-current circuits on account of the fluctuations in voltages, but thought that the future will produce a reliable lamp of that efficiency. Owing to the cost of lamps being such an insignificant item compared with the energy required to operate them, the station manager can afford, if necessary, to pay a better price for a 2½-watt lamp giving one half the life of a 3-watt lamp, from which it follows that the lamp of the longest life or the cheapest in price is not the most economical to buy.

In answer to a question as to the price of 2½-watt lamps with a guaranteed life of 500 hours Mr. Buckley stated that there were several manufacturers getting out lamps of that efficiency, and that the price was 20 cents. He added that 2½-watt lamps guaranteed for 500 hours or a 2-watt lamp with a 300-hour life would greatly improve the competitive strength of certain stations, and that any station now using 3-watt lamps through substituting those of 2½-watts will save enough in coal bills to buy all the lamps of the higher efficiency needed.

Mr. Howell stated that lamps of 2½-watts have a life of only 30 per cent. of the same lamp burned at 3.1 watts per hour; that is to say, any lamp that will give 1000 hours' life at 3.1 watts would have a life of only 300 hours at 2½-watts, while the rate of deterioration in candle-power would be 60 per cent. greater in the lamp of higher efficiency. He submitted the following table, which,

Per Cent. Variations from Normal Voltage.		Per Cent. Normal cp.	Per Cent. Normal Watts.	W. Per Candle.	Per Cent. Normal Current.	Per Cent. Normal Life.	Per Cent. Rate of Deterioration.
	10	47	19.8	4.69	11.1		
	9	43	18	4.46	9.9		
	8	39	16.1	4.26	8.8		
	7	34.8	14.2	4.08	7.7	370	
	6	30.5	12.2	3.92	6.6	280	65
Low	5	26	10.2	3.76	5.5	200	52
	4	21.3	8.2	3.62	4.4	145	40
	3	16.4	6.2	3.48	3.3	95	30
	2	11	4.1	3.35	2.2	50	20
	1	5.6	2.1	3.22	1.1	22	10
Normal		100	100	3.1	100	100	100
	1	5.9	2.1	2.99	1.1	19	10
	2	12	4.3	2.89	2.3	34	20
	3	18.2	6.5	2.8	3.4	45	30
High	4	24.6	8.8	2.71	4.6	55	40
	5	31.3	11.1	2.62	5.8	64	50
	6	38.4	13.4	2.54	7	70	60
	7	45.7	15.7	2.46	8.4	75	

(Per Cent. Decrease / Per Cent. Increase)

he says, agrees with similar tables made up by lamp manufacturers in England and America, and shows the variation of the candle-power, energy, life and deterioration, with variations from normal voltage.

Mr. Terry dwelt upon the more rapid deterioration of candle-power of the 2½-watt lamp. In stations where the voltage varied more than 3 per cent., which would include the majority of stations he said, the 2½-watt lamp could not be used at all, and that in stations with excellent regulation he does not believe it would be found satisfactory. A 16-cp, 3.1-watt lamp will have an average candle-power during its life of, say, 14 candle-power, so that the average watts consumed per actual candle-power will be 3.57. A 2½-watt lamp, giving at first 16 candle-power, will soon decline to 12 candle-power and then down to 8 and lower before it burns out, so that the average candle-power will be perhaps 10, and if the voltage consumed is 40 watts, the average consumption of energy is 4 watts per candle, though this would be changed somewhat if the lamps were not left in the socket until actually burned out. He stated that at present there are no stations which regulate sufficiently well to have 2½-watt lamps, and few have lamps of 3.1 watts. When stations have improved their regulation, it might be well then to substitute 3½-watt lamps for 4-watt lamps now used, or, in case they have reached a point where they can use a 3½-watt lamp, they might try a 3-watt lamp, but in no case should a high efficiency lamp be used in a poorly regulated station. Mr. Terry stated that the quality of the light is dependent upon the filament used and the care taken in its manufacture, and that it is a mistake to think that lamps of different efficiencies should be built on different lines. He believes that the best practice in the average station of to-day is to use a 3½-watt lamp. He gave the following as an average made up from a large number of stations of the cost of electrical energy per kilowatt-hour.

Fuel, water, oil and miscellaneous material	2 cents
Lamp renewals	0.6 "
Repairs, labor and expenses of all kinds	3.1 "
Total cost of operation	5.7 cents
Deterioration at 5 per cent. on investment	3.0 "
Total cost per kilowatt hour	8.7 cents

The average selling price was found to be about 16 cents per kilowatt-hour. It was also found that the amount of business done was about 26.6 per cent. of the capital invested, or it would take about four years' income to equal the capital.

President Grimm inquired whether Mr. Terry meant to say that central stations were receiving twice as much for the current as it cost them, and in reply Mr. Terry said that the earnings ought to be more than 50 per cent. of the gross receipts. The operating expenses will take perhaps 36 per cent., leaving 64 per cent. to be applied to the following purposes: Sinking fund or depreciation should be 19 per cent. of the gross income or 5 per cent. of the investment; it will take 30 per cent. of the gross income to pay a dividend of 8 per cent. on the capital stock, leaving 15 per cent. of the gross income to apply to a surplus account for new extensions, or 4 per cent. of the capital stock. Mr. Grimm stated that the depreciation is more than 5 per cent. on the investment, but Mr. Terry replied that the repairs were included in the operating expenses, the depreciation named being to cover unexpected losses, such as a man being killed on the line, a fire not covered fully by insurance, losses from poor management, competition, etc. Mr. Grimm, nevertheless, considered that the figures given were very misleading, and Mr. Copeland stated that they did not apply to his case.

At the conclusion of the discussion of Mr. Buckley's paper Mr. Pliny Norcross was elected president of the Association for the ensuing year; Mr. C. D. Wyman, first vice-president; Mr. Higgins, second vice-president; Mr. Thomas R. Mercein, secretary, and Mr. John Schuette, treasurer. The former Board of Directors, Messrs. F. A. Copeland, O. M. Rowe and E. M. Highlands, was re-elected. Mr. Fred DeLand's paper on the "Upbuilding of a Small Town," an abstract of which appeared in our last issue, was then read.

After the opening of the session on the morning of Jan. 16, Mr. L. L. Summers delivered an address on "Station Economics," describing laboratory methods for determining the chemical constituents and heating value of coal, and explaining in simple terms the theory of steam generation. A method was described for laying down load curves for stations, which consists in plotting one curve corresponding to the output and another curve to cover the same period corresponding to the amount of coal used. He gave some data concerning average losses in transformers of all sizes in actual operation, the measurements having been made with a direct-reading wattmeter. It was found that the watts lost in the transformers per lamp capacity varied from 2.25 to 3.03. If the average load on the consumer's premises is about one third the transformer capacity, the watts lost per lamp for the average load would be about three times the figures given. He advised that a portable voltmeter be kept, and arc lamps tested in order that they may be readjusted if they show an increasing tendency toward maintaining a longer arc, since the latter involves a waste of energy through increased E. M. F. required.

Referring to the statement of Mr. Terry, that station operating expenses might average only 50 per cent. of the receipts from customers, he said that this would not leave a very large income, for if 6 per cent. additional is deducted for depreciation, independent of repairs or sinking-fund items, only 6 per cent. is available for interest, which amount should be nearer to 15 per cent.

At the opening of the afternoon session on Jan. 16, Marinette, Wis., was selected as the place of meeting of the semi-annual convention. Mr. Pliny Norcross having declined to accept the presidency, Mr. W. B. Baker was elected to that office.

Mr. J. I. Beggs then addressed the convention. He stated that he considered local State organizations of much greater benefit to electric lighting interests of the country than the National Electric Light Association. He advised that central-station men should not lead legislative bodies to believe that they exist for the purpose

of originating or defeating legislation, but rather for the purpose of enlightening legislators as to what would be for the best interests of the community at large, and therefore for the best interests of the electric lighting companies, since both interests go hand in hand. He spoke highly of the benefit to Massachusetts central stations from its State Electric Light Commission, which he considered protected them from ruinous competition. He referred to the effect the introduction of electric lighting had in increasing the candle-power of gas, and stated that in New York City at the present day the illuminating power of the gas sold there for $1.25 per thousand has been increased from 16 to 25 or 28 candles. He considers that in electric lighting the unit of light must be raised from 16 to 20 or 24 candle-power, but in order to do this it is necessary to have lamps of higher efficiency than at present. The Edison Illuminating Companies are endeavoring to obtain a two and one-half watt lamp having a life of 300 hours, which will enable consumers to be supplied with 20 to 24 candle-power lamps at no increased cost, and thus do away with competition from Welsbach burners, acetylene gas, etc. He differed with Mr. Terry and Mr. Howell that a higher price would have to be paid for this lamp, for even should it cost the factories somewhat more, yet as they would turn out twice as many lamps, they could sell them at a less profit.

Mr. Beggs referred to his struggles in Cincinnati and stated that he had there fixed rates on the basis of an initial rate of 15 cents per kilowatt, and running down by a schedule of discounts proportionate to the quantity consumed; a man using $50 worth of current per month gets a discount of 30 per cent. for quantity and 5 per cent. for cash in five days, bringing down the cost of his light to the equivalent of gas to $1 per thousand, and he considers that a system like this must ultimately be adopted by all electric lighting companies in the country, as it has been done in some of the larger cities. He stated that he knows it to be a fact that in a large number of alternating-current stations throughout the country, not more than 30 per cent. on the average of the current produced was delivered at the lamps or paid for, not taking into consideration certain isolated stations which were running down as low as 20 per cent., because of the constant loss during 24 hours of each day through the use of small converters. He considers that money could be saved by having a boy watch the pressure regulators of incandescent stations constantly, to say nothing of the greater degree of satisfaction to customers and the ability to use a higher efficiency lamp.

In conclusion, Mr. Beggs repeated that the unit of light should be raised from 16 to 24 candle-power, and that it would be possible commercially by the introduction of a two and one-half watt lamp, for stations to run as many of the more efficient lamps as of the present ones, and thus be able to give the customer the benefit of the increased economy, thereby also discounting competition from any other sources of light.

Mr. Cunningham next read a paper on the "Arnold Electric Power Station," which was abstracted in our last issue, and was followed by Mr. John C. McMynn with a paper on "Acetylene Gas," which is abstracted elsewhere in this issue.

Mr. Cutter, in the discussion which followed the reading of the latter paper, said he thought that acetylene gas could be made a very valuable adjunct to electric lighting plants if the difficulties incident to its manufacture could be reduced. He said that the Pittsburg Reduction Company after a long series of experiments considered the manufacture of the gas as unworthy of its attention. He took exception to the statement of Mr. McMynn that the process of the manufacture of this gas was the invention of Mr. Willson. Calcic carbide, he said, had long been known in Europe, and the first method of manufacturing it in an electric furnace was described by M. Moissan, a Frenchman, while the carbide had for some time been made commercially at Schauffhausen, Switzerland, where it is sold in sealed cans at about six cents a pound. One half a pound of calcic carbide, Mr. Cutter stated, is produced with 1-hp hour of electrical energy or 50 pounds for 100-hp hours, which latter amount would produce 285 cubic feet of acetylene gas, equivalent to between 2800 and 3500 cubic feet of ordinary illuminating gas; one pound of calcic carbide produces 5.7 cubic feet of acetylene, which would equal about 70 or 75 cubic feet of common coal gas. He stated that an official of the General Electric Company made a report to the Edison Electric Light Association, in which the cost of producing a ton of calcic carbide on the basis of electric power at $20 per year of 24 hours daily; of lime at $5 per ton, coal at $3 per ton, and a cost of 50 cents per ton for crushing, and something for wear and tear of the furnace, which latter is admitted to be guesswork, the resulting figure being $25.15 per ton, not considering any by-products, such as the lime, which, it is claimed, can be used over again.

Mr. Beggs said that he has failed to see any one thus far who claimed that a pound of calcic carbide can be made with an expenditure less than one half a horse-power-hour of energy, and, therefore, more light can be produced with the same expenditure of energy by means of incandescent lamps than with acetylene; the latter therefore cannot be used for commercial purposes unless power could be gotten for nothing. He added that the gas is difficult of distribution, requiring much stronger pipes in which to deliver it, and it cannot be delivered in the ordinary house gas pipes on account of being much more penetrating; it is explosive in its character and the gases thrown off are very obnoxious and poisonous. There are few places where cheap power can be obtained, and if the carbide is made at Niagara, Mr. Beggs doubts even then the ability of the company to put it in competition with other illuminants and this, he said, is the opinion of many of the best gas people throughout the United States. In Philadelphia a company was organized for $2,000,000, the first million of which was paid in at par, but the stock has dropped since then to less than 30. Most of the sales of rights thus far have virtually been made from one set of men as owners of the so-called acetylene patents, to themselves as owners of some large gas companies; these men virtually taking money out of one pocket in small amounts and putting it into the other in much larger amounts. Mr. Beggs stated that some friends of his had some of the best patent lawyers examine into the patents, and that the latter expressed the opinion that there was no fundamental patent and nothing to prevent any electric lighting company in the United States or any individual who could make this calcic carbide from entering into its manufacture. Mr. Beggs believes that even now calcic carbide cannot be made in large quantities for less than $100 per ton.

Mr. Cutter remarked that acetylene will unite with copper and brass to form an explosive that a little jar at the fixture will set off. Mr. Arnold said that the cost of carbide at Spray, N. C., is $23.41 per ton, figuring on the basis of horse-power at $5 a year, negro labor at 60 cents per day and with a very small proportion of superintendence and labor included. In some calculations as to the cost of production in Chicago, with the results at Spray taken as a fair basis, he figured the cost to be $60 per ton, the cost of yearly horse-power at Chicago being taken at $45 per year, including operating expenses and interest on investment of plant. Mr. Summers stated that M. Moissan, the French savant, claims to have produced all kinds of carbide commercially before Mr. Willson's process was used, and his claims, it was added, may eventually cause Mr. Willson's patent to be contested. Attention was called to the fact that acetylene gas cannot be produced in very small plants, as it requires at least 25 horse-power to produce the arc and a much greater horse-power to produce the gas commercially—200 horse-power are used at Spray, N. C., and about 100 and 2000 amperes. Mr. Arnold added that 144 horse-power used at Spray had produced a pound of calcic carbide.

A paper by Mr. F. E. Drake on "Economical Results in Modern Isolated Arc Lighting" was received subject to some changes suggested, and a paper by Mr. Willson on the subject of "Water Purification by Steam" was received without reading.

Domestic Electric Lighting.

On the subject of house-wiring, says the London *Electrician*, the consumer no doubt has his opinions, inarticulate at present, probably illogical, but possibly worthy of some consideration. One of the many merits of iron-barrel and of concentric wiring is that they are calculated to remind the consumer of the familiar gas-pipe. The external resemblance between the early railway carriage and the old stage coach induced many a timid conservative to adopt the new mode of locomotion, and if the householder finds that, in lieu of a maze of mysterious-looking wires in ugly wooden troughs, something bearing a striking resemblance to his old familiar friend, the gas-pipe, is all that an installation of the electric light need involve, he may come to regard the adoption of the new mode of illumination less as a bold departure and more as an inevitable matter of course. Apart from the aforesaid graver considerations of safety, the average householder will probably consider the best form of wiring to be that which looks simple, costs little and gives the least trouble. He, at any rate, poor man, does not wish to be forever drawing wires in or drawing wires out.

Electric Elevators.*

BY FRANK J. SPRAGUE.

Some idea of the extent of the present elevator business may be gathered from the fact that in New York City alone there are not less than 5000 elevators of various kinds, more, in fact, than there are street cars, and more people are carried vertically than there are horizontally.

The elevator field, indeed, is a large one, and if the system is electric, then, considered from a commercial standpoint, there appear the following possible classes of work :

1. High-speed passenger service where no hydraulic plant is possible, because of limited space.

2. High-speed passenger service in competition with hydraulic plants, the electric plant doing equal duty, costing less, occupying less space than the hydraulic, and costing much less to operate.

3. Substitution of new high-speed electric service in place of old steam and slow hydraulic services in buildings where the limited space and interference with operations will not permit consideration of a new hydraulic plant.

4. Passenger elevator service in buildings where the loads are comparatively light.

5. Passenger service in private houses where safety, simplicity and noiselessness are essential.

6. Freight and special classes of work.

For convenience we may classify elevator work as "first-class, that requiring speed from 300′ to 600′ a minute," including the first three duties above mentioned, and as "second class, those requiring speeds of from 50′ to 250′ a minute," which include the remainder.

In general, there has been required and developed two kinds of machines to perform these services. The first is the outcome of the increased height of buildings and the demand for high speed and smooth motion, largely regardless of cost of apparatus, space occupied, or cost of operation. To meet these conditions the electric elevator to be described later was designed.

The second class of elevator work, that which requires lower speeds, is applied to small apartment houses and other buildings where lighter elevator duty is required. This, for a long time, has been fairly supplied by worm-gear elevators, and the replacing of the steam engine by an electric motor has enormously broadened the field for this class of machine.

On light service, such as house automatic machines, and a low class of freight work, a single gear with double ball thrust bearings is used, and on heavier work, a right and left handed gear generally cut on the Hindley form, to give the fullest amount of gear surface, and with the shafts connected by independent machine-cut spur gearing, which allows the worm gears to be free from each other.

Taking the drum type and considering electrical control on a machine over-balanced for average service, the load up or down is sometimes with and sometimes against the machine. To control such a machine directly from a supply circuit (and any other cannot be seriously considered, no matter how ingenious or refined, as meeting general conditions), there is one method only, and that is the use of a rheostat in starting, and the inverse variation of the strength of the shunt field for about a two to one variation in speed. A cumulative series-coil is only permissible in starting if variations of speeds are controllable, and in any event these variations are limited. Such a machine is, however, the best for second-class service. An important branch of this industry, and one which is destined for very wide application, is an automatic house service, the machine to be controlled without an operator, and so installed as to be as safe as a stairway.

Briefly, such a machine, on the Sprague system, is equipped with an interlocking switch device on the machine, having a co-ordinating movement with it, and with the controlling circuit in series with a number of door switches automatically opened or closed with the doors. The doors themselves are fitted with mechanical locks, allowing a car to be opened only during a range of movement from six inches above to six inches below.

At each floor is a single controlling button. If the machine is at rest, the pressing of a button calls a car, wherever it may be, to the particular floor at which it is wanted, where it automatically stops. When the door is open it cannot be started, and when running, no one else can call it from the floor for which it is destined. The machine also has an additional control in the car, and the safeguards attending its operation are such as to make it safe for servant, nurse, child or invalid.

The development of the multiple screw elevator was undertaken for the express purpose of supplanting in a large way the former standard for high-duty office service, and although not by any means an easy problem, either electrically or mechanically, a knowledge of what the hydraulic elevator is, and the variation of the types existing, gave adequate reasons for its attempt.

To meet the hydraulic machine there was designed and developed what is now known as the Sprague-Pratt multiple sheave electric screw elevator, following the general lines of a tension hydraulic machine in the matter of rope movement, limit safeties and method of control.

The net result has been that this machine now stands the superior to the hydraulic elevator in that it has its speed and capacity with, if anything, greater safety, and certain advantages in its automatics. On high lifts it occupies less space ; it is more flexible in its application, is more economical to operate, and it is more easily cared for.

General Description.—The machine may be described as the combination of two old elements with one new one, with specific safeties and methods of control.

Briefly, it is of the horizontal multiple-sheave type, with a traveling crosshead and frictionless nut driven by a screw revolved by a motor directly connected, and governed by a pilot motor and rheostat.

The general construction consists of a heavy main beam, carrying the traveling crosshead and the lower screw bearing, with special castings bolted at each end, one carrying the fixed set of sheaves, and the other the thrust bearing, brake and motor. The regulating apparatus is independent and self-contained, and is placed on the wall. From the car to the system of multiplying sheaves the direct multiplying machine and the horizontal hydraulic elevator are practically the same. The crosshead, however, marks the point of departure in the two types.

In the hydraulic machine this crosshead is rigidly attached to the end of a rod, which terminates in a piston, moving in a cylinder having an inside length equal to the lineal movement of the crosshead. This cylinder in the vertical type of hydraulics varies from 30 to 50 feet in length, with from 2 to 12 sheave multiplications, and in the horizontal types the multiplication runs as high as 14, with corresponding diminution of length of cylinder and increase in cross-section. Whatever the gearing, however, the length of cylinder is a function of the car travel. In this electric elevator, the crosshead being moved along a screw, stationary so far as the lineal movement is concerned, there is, with any given number of sheaves—only one variable—the length of screw ; and, for all heights above about 100 feet, the electric machine has an advantage in matter of length, which, with increased rises, becomes of great importance.

Looking to the needs of office buildings, there has been adopted two methods of rope multiplication, determined by the height of building, and so selected that the length of machine over all, shall not exceed about 30 feet for rises approaching 300 feet actual car travel. From this the length grades down to about 21 feet, so that all rises between 60 and 300 feet can be taken care of with an extreme variation of 9 or 10 feet in the length of machine, and there is thus provided limiting dimension data of great convenience and utility.

To these systems of multiplication the term direct and indirect may be applied. In the former, the entire multiplication, varying from 6 to 10, is done at the machine, and the ropes lead from the end sheaves over the shaft sheaves direct to the car. A free counterweight is used, the ropes being fastened to the car frame. In this method, which is that common to all horizontal and to many vertical hydraulic machines, the hoisting and counter-weight ropes have unequal duty; furthermore, the ropes having the maximum bending, travel on the outboard sheaves at the same speed as the car. This last is the case also with all vertical hydraulics. In some of the latter, the counter-weight is carried in the cylinder on the piston, or in the strap, or both, its weight being as many times that of a free counterweight as there are multiplications. Sometimes both methods are used.

Economy of operation and smoothness of movement, however, are antagonistic in their relations to the amount of counter-weight carried. The best method is probably that used when there is a single multiplication in the shaft, giving a two to one counter-weight traveling at half speed, and carried by all the car-hoisting ropes, as is done for short-rise vertical hydraulic elevators.

For long rises a combination vertical and horizontal machine rope practice has been adopted, giving even a more compact machine, a

* Abstract of a paper read before the January meeting of the American Institute of Electrical Engineers. See also THE ELECTRICAL WORLD of April 21, 1894, for illustrations of the Sprague-Pratt elevator.

longer life of ropes, and better counter-weight results. In this indirect system there is a division of multiplication, which, while having the same effect so far as speed of car and length of machine are concerned as a high direct multiplication, has an entirely different result in the wear on the ropes and the amount of counter-weight which can be carried without jumping.

This is accomplished by making one-half the multiplication (6 or 8) on the machine, the ropes, properly proportioned, going thence to the bottom of the counter-weight frame, which has a single multiplying sheave on top. The car ropes go over the shaft sheaves, under the counter-weight multiplier, and back up the hoistway, where they are anchored, giving a car speed twice that of the counter-weight. The equalizing chains, used to make the pull of the car with any given load constant at all points of the hoistway, are fastened to the bottom of the counter-weight frame and anchored in the hoistway. The space occupied by this multiplier is only two or three inches more than by ordinary form of counter-weight. A proportionally shorter screw, fewer revolutions, and sheaves of greater diameter, characterize this type of multiplying machine.

This system seems to be the best yet devised for long rises, for not only do all the car ropes do equal duty, both with relation to the hoisting strain and the counter-weight, but the rope wear must be less because of the division of speed and multiplication, the necessity of changing only one-half of the ropes at a time, and the possibility or reversal of the ropes on the multiplying machine to get a new wear.

Where space is limited, a double-decked machine is used, and in the new Commercial Cable Building, which is to be 21 stories high, the machines will be treble decked, and about 10½ feet in height.

Details.—Turning now to the detail construction and operation of this machine, there are a number of features claiming special attention, each unique in character, and marking a radical departure from all other elevator practice. These are the nut, screw and thrust-bearing, the brake, the motor and the regulator apparatus.

One of the most interesting as well as important features, and, perhaps, the one which has been most frequently attacked, is the nut system. It joins the crosshead of the traveling sheaves by a conical seat. There is no fastening between the nut and the crosshead, the continual weight of the car always keeping them in contact; and the friction at this point, being greater than between the nut and the screw, enables the latter to transmit a straight-line movement to the crosshead when the screw is revolved by the motor, and also to revolve the screw and drive the motor as a dynamo when the mechanical brake releases the screw to allow the car to descend. These are the normal functions of hoisting and lowering. There are several other distinct functions of this nut which will be described in considering the "safeties."

Continuing the line of transmission of power, the only points of contact between the interlocking nut and screw are by a chain of balls which occupy a number of threads, and enter and leave the ends of the nut through tubes which are connected together so as to make a continuous conduit. This is one of the most vital points of the elevator apparatus, and herein lies one of the most potent reasons of its success—the reduction of friction by rolling instead of sliding surfaces on almost all parts under pressure; for not only is the nut so constituted, being in fact a developed spiral thrust-bearing, but the thrust-bearing at the motor end of the screw is taken on balls and the sheaves are carried on ball or roller bearings.

This nut being a vital part, its development has been most thorough, and a peculiar treatment of steel which has been adopted renders its surface so hard that the wear is very small, and it is well within commercial limits.

So free is the machine from static friction that it is possible to start the car with a very slight increase of current over the normal hoisting current, providing time be taken, so that the work done in acceleration is small to the work of lifting, although that is not the usual practice. The balls have an average crushing strain of 25,000 pounds each, but the working pressure varies from only 50 to 125 pounds per ball.

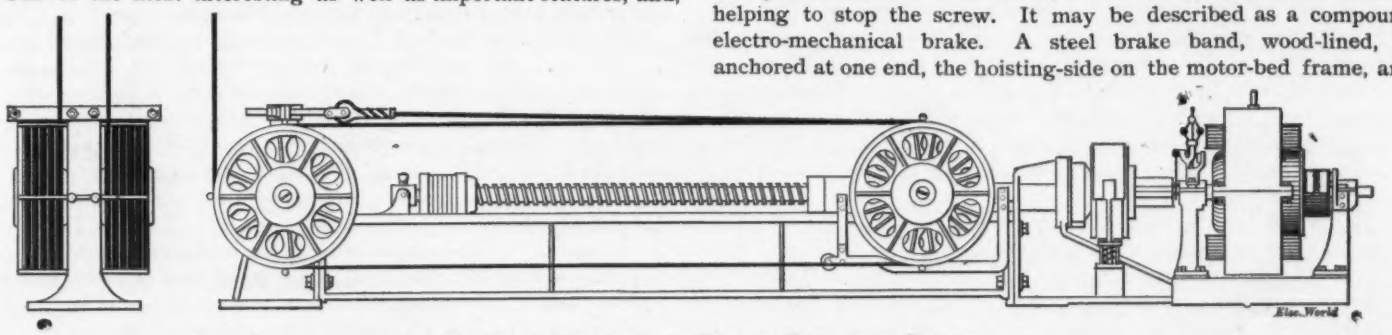
The nut system is a compound one, for, besides the working-ball nut there is another, called the "safety-nut," to which reference will be made later, keyed to it, and between the two is a powerful spring under compression.

The screw is a forged bar of high carbon steel, with a peculiarly shaped thread, the finished screw having a tensile strength of 700,000 pounds. It passes through the clearance hole in the steel trunnion crosshead, which carries the traveling sheaves, then through the nut, and is carried at the outer end by a fixed bearing. This screw is sectioned, being joined to the armature shaft by a one-seated coupling, secured by a taper gib.

The in-board end of the armature shaft, which is, in effect, the extension of the screw, terminates in the thrust-bearing, where the pressure is taken by about 200 steel balls carried in a bronze guide plate and bearing, by specially hardened steel discs. The thrust of the screw being thus taken up on the in-board end, the strain on the screw is invariably between that end and the traveling crosshead—never beyond this; hence, it is always under extension strain—never under compression, and cannot buckle.

The action of the balls on the screw, which is untreated, is peculiar. They form a path for themselves, partly by wear, but principally by rolling compression of the steel, which finally becomes exceedingly hard, such that the edge of any ordinary machine tool would be turned. The balls themselves wear very evenly. Oblique forms in normal practice cannot exist.

Beyond the thrust-plates is keyed an iron pulley, connected by a flexible coupling with the motor shaft. The function of the brake is that of locking the screw when at rest; it is not a means of varying the speed. In case of accident, it has the additional function of helping to stop the screw. It may be described as a compound electro-mechanical brake. A steel brake band, wood-lined, is anchored at one end, the hoisting-side on the motor-bed frame, and the other end is continually pulled down by a powerful spring under compression. The mechanical movement in opposition is through the medium of a peculiar magnet. It is operated by a dual circuit, one in hoisting, another in lowering. In the event of failure of current for any reason, or too high a speed on the down run, this magnet releases the brake in the latter case by a snap switch, operated by an adjustable Pickering centrifugal governor driven by the main screw—and the brake band promptly grips the brake wheel softly yet powerfully.



SPRAGUE-PRATT ELEVATOR IN POSTAL TELEGRAPH BUILDING.

Motor.—The motor, which is of the multipolar type, is carried on the same casting which contains the thrust bearing. The field magnets are of steel and are excited by two circuits; one, known as the shunt circuit, being variable in strength at will, so as to vary the maximum speed of the machine, and the other, a series circuit which acts to strongly compound the field. This type of elevators is differentiated from all other electrics by the fact that the action is like that of the hydraulic, for it always works against gravity. In hoisting the motor takes current from the line, but in lowering its main circuit is cut off from the line, and the motor, rotating in an opposite direction, is driven as a dynamo by the weight of the car. A strong element of safety exists in the fact that the current in the field coils is never reversed, and consequently the machine is never demagnetized. Hence, under certain conditions of the operation of the safeties, it has a power of self-excitation which is of importance.

The armature which turns in this field is of the ironclad type, and not liable to injury of any kind. It is mounted on a sleeve, is of the two-path series winding, has a very large commutator, and, of

course, multiple carbon brushes. The field coils can be removed without disturbing any other part.

Control.—Considered in its simplest form, and in connection with its action upon the motor and multiplying machine, without reference to the means of communication between the car and the regulator, this last is a very simple device. It is composed of two parts, each made up of peculiarly shaped iron grids of various sizes arranged in circular form, connected to copper contacts on a slate disc over which passes a heavy carbon brush.

The use of iron castings of a specific composition possesses the great advantage over any form of wire resistance, not alone in the matter of cost. They are flexible, they expand in any direction readily, and, as made, they have a resistance of from forty to fifty times that of copper, or roughly, that of German silver. The grids are interchangeable, and any of them can be readily replaced.

One side of the rheostat is for regulation in hoisting, the other for lowering. Instead of moving this regulator by hand, it is operated by a pilot motor wound with a right and left handed field, one or the other of which only at a time, can be in circuit with the armature. This pilot is connected to the rheostat arm by a single-reduction worm gear, and is operated either from the basement or the car, according to the position of the "change over" switch, by an "up" and "down" button with an automatic lever stop, which normally has to be held by the operator to prevent the pilot returning to a stop position. The spindle of the rheostat arm operates switches co-ordinating in their movement, in turn controlling the magnetic make-and-break circuit switches, the down brake, and also the automatic stop lever switches, which limit the pilot movement.

The use of magnetic switches instead of hand control switches not only removes the arcing from the face of the rheostat, but it give the benefit of instantaneous cut-offs not possible by any other means of control.

This, on fast machines, is of the utmost importance, and the practical application is that if a car is on the "up" motion, and an operator, because of carelessness or because of fright lets go his stop handle, the current is instantly cut off, the regulator following to stop, and the car is arrested in the shortest time practicable.

Assuming that the circuit is made for the up movement, it first meets with a resistance sufficient to about hold the car and lift the brake. This resistance i s then gradually cut out, the torsional effort of the armature is increased, giving the car an upward movement with an acceleration depending upon the rate of movement of the rheostat arm, and with a final velocity determined by the point at which the arm is stopped.

If, while hoisting, for any reason the current is cut off, the torsional effort ceases, the brake instantly comes into action and the car comes to rest. In lowering, the brake is lifted by an independent circuit, but the armature is first short-circuited on itself, and becomes a most powerful dynamic brake. As the resistance in this circuit is increased, the car runs faster. When it approaches the lower limit of movement, an independent retarding circuit is established, and gradually reduces the resistance. This brings the car to the slowest movement.

The pilot movement regulation is an absolute necessity of fast passenger work; and its application, although at first attended with a number of annoying difficulties, is to-day by far the most reliable method of control known.

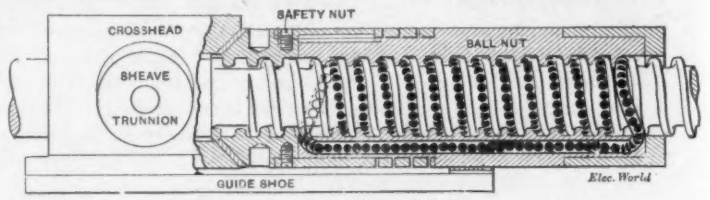
Safeties.—Of course, the vital question to be considered in any elevator system is that of safety, and in that respect the elevators amply provided. Safeties may be considered under two heads: First, those on the car, and second, those on the hoisting machine.

On the car there is used a special centrifugal, which is attached to the lower section of the frame. It consists of two long levers, short-fulcrumed at the sides of the car, and operating clamping jaws which run in close proximity to the car rails, but normally out of contact with them. The inner ends of the levers overlap, and in action are pressed apart by a very powerful spring under compression When out of action, these levers are drawn together, the spring is put under compression, and the system locked by a trigger. Near the trigger is a centrifugal governor, operated by a standing rope, which at a determined speed releases the trigger, frees the levers, and the safeties clamp the rails with a pressure of about 16 tons. This safety can be released from the inside of the car.

In the car, as has already been described, there is an automatic stop contact which operates to bring the regulator to the stop position, and the car to rest in case the conductor removes his hand from the controller because of crowding, accident or carelessness.

On the hoisting machine there are a number of safeties. One which is perfectly apparent, is due to the fact that the crosshead is moved by a screw with a heavy armature on the end of it, which is driven through the medium of a nut by a car of limited driving capacity. The screw itself is of forged steel, under tension and torsion strains, with a safety factor of at least 20 to 1.

The hoisting nut, as already described, is hardened by a specific process which makes its wear very limited. In addition to this there is in the nut system what is called a "safety nut." Normally this is out of contact with the thread of the screw, but it is secured to the



Hoisting and Safety Nuts.

hoisting nut, and should any accident happen to the latter, breaking its hold on the screw, this safety nut, the threads of which interlock with the screw's threads to a greater depth than the thread of the hoisting nut, would then take the place of the hoisting nut and securely grip the screw. This would put the elevator out of operation, because the friction between the nut and screw would be greater than the friction of the traveling crosshead, and it would act simply as a collar on the screw.

The nut system has in addition another function. Since the hoisting nut is only held from revolving by its friction against the crosshead, when the nut gets to the upper limit of its travel the safety nut meets a solid collar on the screw which stops its travel, causing it and the ball-bearing nut to revolve with the screw, without, however, necessarily stopping the motor, and leaving the traveling sheaves to be stopped simply by the weight of the car.

There is still another function performed by the nut system, that of a slack cable device. If for any reason the car in descending, when of course the nut is driven along by the screw, meets an obstruction, the pressure on the nut being instantly reduced, it recedes slightly, allowing the springs between it and the safety nut to expand, throwing the latter into back contact with the screw threads. The nut system then instantly grips the screw, revolves as a collar, and consequently acts as a check against any marked movement of the crosshead corresponding to a free fall of the car on the ropes.

Assuming, however, the condition of a perfectly free release from all operative safeties, there is a limit to the rate of revolution of the screw, and in any event there is a rubber buffer at its lower end which would cushion its stop so as to prevent any injury.

Besides the lower limit switch, which has already been mentioned, which puts an increasing retarding force on the motor, there is an upper limit switch for cutting off the current; this is a self-cleaning lock switch, operating in both directions, and moved by a roll on the crosshead. It cuts off the current in hoisting in the upper limit and allows the brake to come on. On the reverse movement it is automatically closed.

The governor on the machine, which is called a "monitor centrifugal," has already been mentioned. This is for operating the brake when running too fast. In hydraulic elevators there is no speed-operated device in case of fast running, except the centrifugal on the car, and this is frequently set so much above the normal speed, on account of the annoyance of having it operated by a temporary excess, as oftentimes to be useless when actually required. The monitor-centrifugal does not throw the machine out of operation, but simply slows it up to any desired speed, and then allows the operator to resume control.

The dynamic action of the machine is made use of in still another way, by the introduction of an "automatic choking circuit" and switch, operated by the same circuits governing the main brake. It is in constant play, and closes the circuit around the armature and its series-coils through a rheostat under any of the following circumstances: At each stop, from up or down; when running down fast enough to work centrifugal on the machine; on failure of the hoisting current, or on failure of the line current.

So positive is the control over the motor, no matter whether it be operating to hoist the car or retard it in going down, that the brake band can actually be removed and the car still controlled, and even with the brake in normal position the change from one

position to another can be made so promptly that it will remain inactive.

Such is the machine which has been developed during the past three years, and whose first application in a large battery is in the Postal Telegraph Building. As illustrating in some degrees the extent of this industry, buildings of from five to twenty-one stories in height are being equipped with batteries of from one to twenty-six machines of various types, and the business of a single company employing some two or three years ago a handful of men, now demands a constantly increasing force already numbering nearly 500.

DISCUSSION.

Mr. Steinmetz said that while the mechanism described was very ingenious and interesting, he thought that the practice of having the elevator car descend by gravity entailed severe service from the central station furnishing the current to the elevator motors, and interfered with incandescent lights on the same circuit. The car being overbalanced in order to overcome the friction of the mechanism and descend by gravity, required more current to carry it up than would be the case in an elevator system where current was used going both ways, and the fluctuations in the volume of current were therefore much greater in a gravity-return system such as that described.

Mr. Hill criticised Mr. Sprague's comparison of electric and hydraulic elevators, and said that his experience had shown that nothing was better for passenger service than a hydraulic elevator.

Mr. Sprague, in reply to Mr. Steinmetz, stated that current for large elevator plants was seldom taken from central stations. Almost invariably the current was furnished from an isolated plant in the building itself, and the elevator circuits being entirely separate from the lighting circuits, there was no drop of potential on the latter when a sudden demand for current was made by the elevator motors.

Replying to Mr. Hill, Mr. Sprague called attention to the fact that hydraulic elevators require just as much water to run empty as with a full load, while an electric elevator consumes power more nearly proportionate to its load. He also stated that a pretty fair indication of the relative cost of the two classes of service was to be had in the fact that central stations are always willing to furnish current for an electric elevator, whereas they would not supply current for motors driving pumps for hydraulic elevator service. Mr. Sprague gave figures showing the large economy of electric over hydraulic elevators.

Dr. Emery moved that a vote of thanks be tendered Mr. Sprague for his paper, which was done. After some remarks by Mr. Leonard, in which he championed drum elevators as being simple and efficient, further discussion upon Mr. Sprague's paper was deferred to the next meeting of the Institute, and the meeting adjourned.

Regulating and Starting Rheostats.

To the Editor of The Electrical World:

SIR: Referring to the subject of regulating and starting rheostats discussed in the letter from Mr. H. Ward Leonard, which appeared in your issue of the 18th inst., I respectfully call your attention to the fact that in my former letter I stated that my claims were based on actual tests and it would seem to me that, that being the fact, Mr. Leonard should present a more logical argument than his "claims" and, so far as he has informed us, his untried theories.

The fact that motor speed-regulating rheostats, designed and proportioned on the basis of the rheostat described in my last letter, are in practical operation all over the country, and in some cases in fully as severe service as described by Mr. Leonard, is evidence enough to convince me that they are proportioned properly and that Mr. Leonard's theory as to radiation is fallacious.

If the rheostat were a solid cube, such as Mr. Leonard describes, then there would be nearly the condition of "still air," and his theory would be true in a degree, but as the plates are so designed and disposed as to induce the active movement of the air between them in proportion to the amount of heat generated, conditions of practice, and not theories, must determine the proportions.

It may be that Mr. Leonard's observations have been in connection with the use of plates where enamel is used for an insulating medium. In dissipating power with the use of such plates, if the heat rises above a certain point the plates will disintegrate. My observations have been in connection with the use of plates built up in such a manner as to allow for the difference of expansion in the materials used without injury to the plate, allowing the dissipation of energy at a much higher surface temperature than is practicable or possible in the use of enamel plates. I have found it practicable to design rheostats on the lines of the one described, even calculating the maximum watts dissipated per square inch as high as five. I recall one case in particular where a motor is operated at from one tenth to one half speed, and under conditions of full torque, for three to five hours at a time, and at no time is the rheostat out of circuit during the run of 10 hours, and occasionally a run of 16 to 18 hours. Under these conditions the rheostat does not get hot enough to injure the plates nor to injure the slate switchboard on which it is mounted.

Referring to the fourth paragraph in Mr. Leonard's letter the reason that the space is not reduced is simply because it would not be good practice to reduce it; and further, because my calculations are based on the result of practice and not on theory alone.

It is amusing to notice that in Mr. Leonard's letter published Dec. 7 he says the 50 horse-power rheostat, taken as an example, would "reach a temperature considerably above bright red heat." In the letter published on the 18th inst. he qualifies this statement by saying "will reach a red heat." Perhaps, during the course of a few more communications, Mr. Leonard will get his statement of the heating effect down to fact by easy gradations.

WESTFIELD, N. J. GEO. R. COLGATE.

The Lachmann Conduit Electric Railway System.

To the Editor of The Electrical World:

SIR: An illustration of the fact that American inventions frequently depend on their prior introduction in Europe for their introduction here, is illustrated in the following account:

In your issue of Dec. 1, 1894, at page 577, is an account of the so-called Lachmann (air-chamber trolley) conduit for electric railways, and its successful tests during the preceding Summer. On May 4, 1895, you refer again to this system, and its successful tests during the preceding Winter. In your first notice you describe the system as follows:

". . . There is a slotted conduit made up of sections, the top being formed like an inverted box, with the object of preventing any water in the conduit from extending into this box by virtue of the air in it; the conduit, and even the street, may therefore be flooded with water, but the air confined in this box will keep the water from reaching the wire which is supported therein."

If you will turn to the *Elek. Anzeiger* (Berlin), of Nov. 21 last, you will find that eight different bidders were after the contract to equip certain lines of street railways in Vienna with electricity. One of these bidders is the Lachmann above named; others were the Allgemeine Elektricitäts-Gesellschaft, of Berlin, Siemens & Halske combined with two others, and the Union Elektricitäts-Gesellschaft, of Berlin; I am informed that one of the bidders above named is the European end of one of our great electric companies having one or two conduit systems now in operation in this country: the Budapest system of another of these bidders is well-known. Mr. Lachmann writes me under date of Jan. 4, 1896, that the contract was awarded to him and that he will have a line in Vienna equipped with the air-chamber trolley-conduit system by the first of May next. This line successful, he will be enabled to introduce it in Vienna.

The fact that Mr. Lachmann won the victory over such great competitors and competition is highly significant of the merits of the air-chamber trolley-conduit system in respect to its low cost and high efficiency in operation as compared with the other systems.

The *Engineering News* of this city, in its issue of Oct. 20, 1892, contains an article on the air-chamber trolley-conduit system, with illustrations, but under a different title, and names it as an American invention; you referred to this article at a subsequent time. I may add that the construction has been improved and simplified till now the conduit need not exceed 7″ x 5″ outside dimensions, and its cost is nearer that of the overhead trolley with iron poles than to the cost of the systems that competed with it at Vienna. We hope to get a line built in this country this year. R. W. BARKLEY.

NEW YORK.

Electricity and the British Public.

The great British public, says the London *Electrician*, does not affect electrical and medical literature of the solid order; and if it did, quite 96 per cent. would be more or less unintelligible. It is only when the Edisonian oracle across the Atlantic speaks in its well-worn sensational style, or when some unusually gruesome accident occurs to an unfortunate employee, that the general public is troubled by visions of unknown dangers lurking behind the simplest application of electrical energy.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Formulas for Calculating Three-Phase Motors. BEHN-ESCHENBURG. *Elek. Zeit.*, Jan. 2.—The first part of a long article in which he deduces comparatively simple formulas for use in calculating and examining three-phase motors. In many cases in practice such motors cannot be calculated sufficiently accurately by means of theoretical approximations based on an analogy with continuous-current motors; the results of a true theory, he believes, are not yet sufficiently simple to be used in practice; in the present article he endeavors to give a series of formulas which he has found very convenient in practice (presumably at the Oerlikon works). The analogy of the theory of multiphase motors and of transformers is so great that formulas for the motor are easily obtained if in the well-known formulas for transformers the induction coefficient of the secondary system is multiplied by the frequency of the relative motion, instead of by the full frequency. He limits himself to the three-phase motor, as he considers that it is unquestionably the most perfect of the multiphase motors.

LIGHTS AND LIGHTING.

Holophane Globes. GUILBERT. *L'Eclairage Elec.*, Dec. 28.—A continuation of his article, giving illustrations showing how the globes are constructed, and some interesting experimental results obtained in measuring the normal, horizontal and vertical illumination along a horizontal line at a certain distance below the lamp, the curves being given for a naked light and for various different globes; in general these curves for a ground glass globe are somewhat similar in outline to those of the naked lamp, although the intensities are considerably less, and there is a tendency toward diffusion; the curves for an "opaline" and an opal globe are similar in general outline to that for the holophane globe, although the intensities are considerably less; all the latter three differ decidedly in outline from the two former; these curves are those of Prof. Blondel, recently published in a non-electrical French journal (a reprint of which—long article—is published in pamphlet form). Experiments showed that the absorption in the holophane globes does not exceed 10 per cent., while that in the ground glass globe reaches 30 per cent. A similar principle to that of the holophane globe might be applied to globes for alternating-current arcs, they being so arranged that the light above the horizon is all totally reflected; no such globes have been constructed, as the development of alternating-current lights has not yet justified it; for continuous-current arcs the holophane globes seem to be a great success.

Public Lighting with Arc Lamps. BLONDEL.—The long series of articles, which were recently abstracted in these columns, are published in French, in pamphlet form, by the publishers of *Le Genie Civil*, the journal in which they originally appeared.

Ventilated Enclosed Arc. Elec. Eng., Jan. 15.—A brief description of the new form of the Marks lamp the earlier forms of which were described in the journals some time ago. The bottom of the globe is sealed, but the top contains openings arranged with a view to allow a limited circulation of the air; the hot air escapes through an opening around the upper carbon, while the fresh air enters at the top of the globe, is deflected so as to pass down along the inside surface of the globe and then up around the carbon. He states that in this form the resistance of the arc remains practically the same as in an open-air arc, and the length of the arc is therefore also the same; the electrodes do not burn blunt as in the ordinary enclosed arc, but are more like those formed in the open air; these lamps are said to run at 45 to 50 volts, the carbons having a life of 50 hours.

Absorption in Transparent and Translucent Glass. STORT. *Prog. Age*, Jan. 15.—A translation, with the illustrations, of the article abstracted in the Digest, Sept. 7.

POWER AND HEAT.

Proposed Water-Power Plant on the Chicago Ship Canal. PUTNAM. *Elec. Eng.*, Jan. 15.—A reprint of a recent paper. He gives suggestions for a large water-power plant on the drainage and ship canal at present being built for Chicago, as there will be an available water-power there, which can be developed and utilized at a comparatively small expense; the total available power he estimates at 65,700 hp in two steps of nearly equal amounts at Lockport and Joliet; he thinks that Chicago, with a present daily consumption of between two and three hundred thousand hp offers a good market for this power and he endeavors to show that it can be transmitted economically and profitably. There would be turbines of 3000 hp each; the cost of the entire power-plant ready to run will be about $10 per hp, which figure he thinks can certainly be reduced; the distance to Chicago is 40 miles; the number of alternations is not to exceed 30 in order to avoid the induction losses which would be excessive at a higher frequency; the voltage of the generator should be about 2000; the polyphase current is to be adopted; the line voltage is 20,000; 3000 tons of copper will be required, consisting of 30 circuits of 3 wires each of No. 0 wire, for a loss of 10 per cent.; the wires are to be bare copper and the distance between them 12 inches. Power would be furnished to companies at present engaged in the generation of electricity; local companies would be organized to distribute the power. An estimated cost of a plant gives the total as $3,000,000; the rental of the 50,000 hp will be at the rate of $25 a year; interest, depreciation, labor, etc. $290,000 deducted from this, leaves an excess of income over expenses of nearly a million dollars, from which $5 per hp rental to the drainage district should be deducted, leaving a profit of 27 per cent. on the investment.

Arc Welding. HANDY. *Elec. Power*, January.—He gives a general review of the practical progress of welding and metal working by electricity, with particular attention to the arc method; he gives abstracts from the most important articles, most of which have already been noticed in THE ELECTRICAL WORLD.

TRACTION.

Electric Railways and Telephonic Disturbances. PRELLER. Lond. *Elec.*, Jan. 10.—He gives the results of an investigation of the effects on telephones due to electric railways on a number of lines, in order to determine which of the different overhead contact systems is most liable to cause such disturbances, and whether they are due to induction leakage or other causes. In Zurich there were serious disturbances, and on these lines the usual trolley system was used; at Geneva, Bale and Mulhouse he found that even on lines in close proximity to the railways the disturbances were so insignificant as to be practically negligible, and there has been no complaint; in Geneva, a slide-contact shoe is used, while at Mulhouse the well-known "cross-bow" system of Siemens & Halske was in use; at Marseilles the disturbances were similar to those at Zurich; in general, where the trolley was used there were disturbances, while there were none where the slide contact was used. Although electromagnetic and electric induction must take place between parallel wires, yet he gives reasons to show that the phenomenon in Zurich is not primarily and certainly not entirely due to induction; the primary cause of disturbances must, in his opinion, be sought in the trolley system itself; there is a marked difference in the mode of suspension in the trolley and the slide-wire systems; the former requires a large number of points of suspension, especially on curves, while there are few for the latter system, and at crossings the wires are simply soldered together, while in the trolley system there is always a jump; leakage therefore takes place through defective contact, and it is this latter which, in his opinion, constitutes the primary cause of telephonic disturbances; the view was confirmed by a trial on the Zurich line, in which the slide contact was temporarily substituted, which show that the sparking and the effect on the telephones remain practically the same, and that therefore the fault lay in the overhead system which the trolley wheel involves. Another cause which intensifies the effects lies in the construction of the motors, those using chain gearing being much more noiseless than those using spur wheels. The trouble is somewhat mitigated by substituting trolley wheels with a wide groove of 1.8 inches, for the ordinary narrow groove trolley wheel, thus allowing more lateral play; it is often contended that a contact slide wire wears the contact wire, but this is a fallacy; as, according to his experience, the reverse is the case, namely, that the slide contact piece being always made of softer material, is the one that wears; in the aluminum cross-bow at Bale, the wear is reduced to a mimimum, the contact surfaces being well greased. No trouble has been experienced in telephonic disturbances on the Isle of Man line on which the cross-bow system is used, although the telephone wires run for two miles not more than 25 feet away from the railway conductors, but they have metallic returns; the same was found on the Mont Saleve railway. He concludes that if overhead wires are tolerated at all, the slide-contact system already in operation in a number of cities is free from any of the disadvantages inherent in the trolley system, and therefore marks a conspicuous advance.

Tractive Resistance of Tricycles. RAVENSHAW. Lond. *Engineering*, Jan. 10.—He gives the results of some tests made to determine the tractive forces which he thinks are correct within 10 per cent. and sufficiently close to use as a basis for electric or other motor cars. The tractive forces were about the same for all speeds up to 12 miles an hour; the re-

sults show the immense advantage of pneumatic tires over solid ones; he expresses surprise at the comparatively high tractive force required, believing that tests with a light cart have shown a resistance of only 20 pounds per ton. A very heavy pneumatic-tired tandem tricycle weighing 120 pounds varied from about 31 to 35 pounds per ton on flint and asphalt pavements, increasing up to 73 in heavy mud; for a solid-tired tricycle weighing 50 pounds the tractive force was 60 pounds per ton and in heavy mud 146; for a pneumatic-tired tamden bicycle weighing 50 pounds the tractive force varied from 30 to 33 pounds per ton on flint roads and 78 to 95 in heavy mud. With accumulators giving 6 ampere-hours per pound it ought to be possible to make carriages not weighing more than 250 pounds which could carry two persons 40 miles without re-charging; if these can be made for $250 they would be within the reach of hundreds who cannot keep a horse and carriage.

Aix-la-Chapelle. Elek. Zeit., Jan. 2.—A long, illustrated description of the railway line in that city, on which the Schuckert system is used. An illustration of the truck shows a frame encircling the whole truck, pointed at each end and carried as close to the level of the street and track as possible, to take the place of the usual fenders; it is difficult to see how a body as large as a human being could get under the wheels with this simple device.

Submarine Boat. Lond. *Elec. Rev.*, Jan. 10.—A translation of the illustrated description of "le Goubet" (see Digest, Dec. 28).

The Booster in Railway Work. SCOTT. *St. Ry. Rev.*, Jan. 15.—He points out the advantages of the use of boosters, more especially in connection with an increase of travel for short periods, and gives a brief description of a satisfactory application of such a booster on a line in Baltimore, where it has been in use since July. The fields are wound with series-coils only, which gives a very satisfactory regulation, the object being to make the increase of voltage at the station just equal to the drop in the line for any given current. A table is given showing a comparison of one case of direct- and booster-feed; the net saving in first cost is worked out for distances from one to seven miles, as also the capitalized cost of power; the saving in first cost is itself thought to be sufficient to recommend the system in many cases where a saving in equipment is of importance; the table shows that when operating 10 hours per day during the year there will be a loss between the saving in first cost and the capitalized cost of operating expenses for a shorter distance than seven miles; when operating 10 hours a day for four months in the year, there is a gain for a little over four miles and upward; for one day a week for four months in a year there is a decided gain at two miles, while at five miles the saving in first cost is over 10 times the capitalized cost of power.

Throwing On a Railway Generator. Elec. Ry. Gaz., Jan. 18.—A reprint with the illustrations of the article abstracted in the Digest, Jan. 18.

Accumulator Traction. BARNETT. *St. Ry. Rev.*, Jan. 15.—A communication which, with the exception of a few omissions, is identical with the one abstracted in the Digest, Oct. 12. The letter is answered editorially. It is thought that "the time has come when it is proper to raise a protest against the wholesale squandering of money in extensive trials of a system that has such a splendid chance of failure. If the system is still worth experimenting with, let it be done on a small scale." The statements and deductions of Mr. Barnett are criticised adversely, and some deductions are made to show that the cost of the battery station would be as much if not more than that of the trolley station, and it is thought that the battery cars will take more power in a given time "because of their nearly doubled weight." It is thought that the conditions assumed for the trolley road and for the battery road are not alike, and that neither the first cost nor the cost of operating is in favor of the storage battery.

Electric Power for Railways. RYAN. *Sibley Jour.*, January.—He gives a brief summary of the discussion concerning the competition of electric railways and steam roads, quoting largely from Dr. Duncan's paper, which was read at the Niagara Falls meeting. In subsequent articles he intends to review the engineering methods now in use and discuss those that will probably be given a trial in the near future.

Electric Brake. ASHLEY. *Elec. Power*, January.—An illustrated description of the brake, which is operated by means of a small storage battery carried on each car; the brake itself consists of a jointed magnet which clasps the shaft.

Submarine Boat. Elec. Eng., Jan. 22.—A reprint of the translation above referred to, including the illustrations.

Submarine Navigation. HOLLAND. *Sibley Jour.*, January.—A long, illustrated abstract of a recent lecture, most of which is historical, and does not refer to electric propulsion.

Ogontz. Elec. Ry. Gaz., Jan. 18.—A brief, illustrated description of the station, which is the newest one of those in Philadelphia.

Brooklyn. Elec. Ry. Gaz., Jan. 18.—A brief, illustrated description of several of the lines.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

High-Tension and Low-Tension Supply. GAY. *Elec. Rev.*, Jan. 10.—He refers to the discussions between the advocates of high and low tension systems, and endeavors to show how fruitless the warfare between them must be. He first discusses the arguments of the high-tension advocates; some of the points brought out are already well understood and will not be mentioned here. Regarding the large capital outlay on mains, he states that it is of not so much importance as the high-tension advocates pretend, as the expenditure of the whole system must be considered and not only that of one part of the plant; referring to the English reports of 1894, he shows that in a certain low-tension plant with a capacity of 370 kw, the cost was $1040 per kw, while with a certain high-tension continuous-current system, with a capacity of 240 kw, the cost was $1300 per kw; in a certain high-tension alternating system of 198 kw the cost was $680 per kw, while in a low-tension plant of 192 kw the cost was $660 per kw; these show the highest expenditure; among those showing the lowest he quotes a low-tension system of 200 kw costing $430 per kw, and another about five times as large, $260, and another of 288 kw at $260, and a high-tension plant of 324 kw $330 per kw; the average cost per kw of all the works in Great Britain is, low-tension, $545, high-tension, $520 but the latter includes Oxford, which if excluded reduces the figure to $485; local conditions materially affect the cost; taking these figures as a basis there is not much in the contention that the capital outlay for a low-tension system is necessarily greater than for a high-tension one. Regarding the heavy loss in distribution, he says only the system as a whole should be considered; the Liverpool company shows the lowest works cost, namely 3.2 cts. per kw-hour sold or about one million units (kw hours), on the low-tension system; the lowest figure for a high-tension system is 3.64 cts. per unit for about half that many units; for the low-tension system at Manchester it is 2.98 cts. for a little over a million units, while for the Portsmouth high-tension station of about one eighth the output the cost is 3.18 cts.; the average for all the stations in Great Britain for 1894 was 5.88 cts. and for low-tension 4.68. He then considers the claims of the advocates of the low-tension system; regarding the dangers he claims that 600 volts, which it is proposed to include under the term of low tension, has not yet been proved to be free from danger; regarding the high cost of the high-tension plant, the averages at first appear to bear this out, but a number of the plants are not of the most modern type; 10 plants that have been running for three years or less, using the high-tension system, shows an average of 4.86 cts. per unit instead of 5.88; there is therefore no reason for assuming that the working cost of a high-tension station is materially greater than for a low-tension one; regarding the argument that the high-tension current cannot be stored, he states that as a means of reserve, comparatively few possess batteries of sufficient capacity to take the whole load in case of a break-down, the majority using them only for purposes of regulation and this is not necessary for an alternating-current plant.

Central Stations in the United Kingdom. Lond. *Elec.*, Jan. 10.—A map showing the location of the central stations, with signs indicating whether alternating or continuous, and whether owned by the municipality or by a company.

Cologne. Elek. Zeit., Jan. 2.—Some deductions and curves concerning the operation of this station for about four years.

Charging Fields for Large Dynamos. DONSHEA method. *Elec. Eng.*, Jan. 22.—The advantage of the self-exciting method is that the field gradually dies away when the dynamo is stopped, thus avoiding the danger of a sudden discharge; the disadvantages are the slowness with which the field is built up, and the possibility that it may be built up reversed. The advantages of the bus-exciting method are that the field is instantly made and the polarity is always the same; the disadvantage is that it is necessary to discharge through a bank of lamps. The advantages and disadvantages of the separate exciting method are the same as those of the previous system, besides introducing a small, unreliable dynamo. The present method, which is claimed to overcome these difficulties, has been used in a number of Edison's stations. One side of the field-coil winding is connected to one of the brushes, the other being brought through the regulating resistance, to the plate of the field-switch which is pivoted on the same axis as that of the main dynamo switch but insulated from it; when closed, it makes connection with the neutral bus-bar; when the dynamo is up to pressure the main switch is closed and a latch then automatically and securely locks them together so that when opened they operate together and are electrically connected; when closed again the latch is first withdrawn. The main circuit and the field are therefore opened at the same time and the discharge of the field takes care of itself in the slowing down of the machine, there being no break in the field at any time; a further advantage is that it gives a larger working margin for the regulating resistance, and that it simplifies the apparatus used for throwing the dynamos from one side to the other of a 3-wire system, as no change-over switch is required and only two cables need be run from the dynamo to the switchboard.

WIRES, WIRING AND CONDUITS.

Rules and Regulations for Germany. Elek. Zeit., Jan. 9.—In an editorial discussion of these rules, a translation of which is published in another column, it is stated that they were unanimously adopted by the committee and may therefore be considered final; there are two points to which special attention is called, as they were considered very carefully and gave

rise to considerable differences of opinion; the first was whether fuses should be proportioned with reference to the current or to the diameter of the wire; although theoretically they should be based on the current strength, great practical difficulties arise in carrying this out; the binding-screws connecting the wire and the fuses would then have to be specially constructed; but for these binding-screws several definite sizes have already been adopted, and it would require many annoying changes; furthermore, if the current at any future time is increased, all the fuses and binding-screws would have to be changed; it was therefore decided to proportion the fuses with reference to the cross-section of the wire to be protected, and not with reference to the current. The second point which was specially discussed is the insulation-resistance required for the plant; until now, two kinds of formulas have been in use; in the first the resistance is equal to the voltage divided by the maximum current and multiplied by a constant; in this the number of lamps is not considered, and as the difficulties of obtaining good insulation is affected by the number of branch-circuits, any formula which does not take into account the number of lamps is not a correct one; in this formula the same insulation-resistance would be required for an installation of a large number of lamps, as for a single motor of the same capacity, while really it should be much greater in the latter case to give the same security. A second kind of formula used by the insurance companies gives the resistance as the quotient of a constant by the number of lamps, the constant depending on the voltage and on whether continuous or alternating currents are used. An illustration is cited in which an installation of 2000 lamps is carried out carefully with the exception of 10 lamps, which have a very low resistance; were they tested separately they would require a very high resistance, but any test of the whole installation would enable the dangerously low resistance of those lamps to be passed. This shows that this kind of a formula is not correct either. It is therefore concluded that not only the installation as a whole should accord with the formula, that the resistance should equal 10^6 divided by the number of lamps, but, in addition, every portion or branch of the installation should have an insulation-resistance which is not less than $10{,}000 + 10^6 : n$, in which n is the number of lamps; the extra coefficient of 10,000 is introduced to guard against the case above cited of a few badly installed lamps. The general adoption of these rules is probable, although they are not prescribed legally.

Earthed Neutral Wire. Snell. Lond. *Elec. Rev.* and *Elec.*, Jan. 10.—He calls attention to the fact, in connection with the proposed use of 400 to 500 volts on a three-wire system, that the full voltage may be brought into one house under certain conditions; assuming two adjacent houses, one connected to the positive and the other to the negative set, and a party wall containing an iron frame or other metallic body, or having a portion of the wall moistened and tolerably well insulated from the earth, and then supposes that this is in contact with one of the outer mains, the leakage to the earth being too small to blow the fuse; then assume an accidental leak on the other pole in the other house; by touching both at the same time the full pressure will be felt; but these two conditions are not likely to occur often at the same time. If the middle wire is earthed, he recommends that all iron work in the buildings should also be effectively earthed, in order to prevent such an occurrence.

Concentric Wiring. Lond. *Elec.*, Jan. 10.—An illustrated description of the method of making a T-joint in this so called "safety" system (see Digest, Dec. 21,) which has been in use during the past five years. The outer conductor, which consists of a large number of fine wires, is cut away, as also the insulation, the central wire is then joined, covered with insulation and the whole laid in a mould into which some molten fusible metal is poured, which connects the outside conductors and vulcanizes the rubber used in insulating the joint, at the same time making it water tight.

Concentric Wiring. Mavor. *Elec. Eng.*, Jan. 15.—The beginning of a reprint of the paper abstracted in the Digest, Dec. 21.

ELECTRO-PHYSICS AND MAGNETISM.

Photographing Through Opaque Bodies. Lond. *Elec.*, Jan. 10.—A brief reference to the newspaper report of the discoveries of Prof. Roentgen (apparently not Routgen; see Digest last week) explaining that while experimenting with some cloth-screened vacuum tubes in a dark room in which some sensitized paper happened to be lying about, he found that the paper became acted upon by the electromagnetic waves; further investigations enabled him to "photograph a human hand showing only the bones and the rings on the fingers," the hand being laid on a wooden case containing photographic paper. The editorial notice says that the whole phenomenon seems likely to admit of ready explanation when the conditions of the experiments are more fully published; no further information is given.

The Lond. *Elec. Eng.* furthermore states that the discovery has been accepted by the well-known Prof. Botzmann, of Vienna; the discovery is that a photographic plate is affected by radiations from Crooke's tubes, which are entirely beyond the range of the visual spectrum; metallic conductors are opaque to these new radiations, while wood and many organic substances are transparent to them: it is suggested that these radiations are an extension of the ultra-violet spectrum, but there is a possibility that they are due to undulations of a comparatively long period; it appears that quite large outputs are required. Another dispatch from London to a daily paper states that even greater success has been obtained in a repetition of the experiments; these new radiations penetrate through aluminum plates one inch thick; an ordinary compass was "photographed" through a number of volumes of books; no lens was used and the photograph is not a negative, but a positive, presumably nothing more than a sort of a shadow. Prof. Thompson calls it a registration of shadows rather than a photograph; it is thought to promise a revolution in surgery and medicine.

Photographing Through Opaque Bodies.—A further dispatch (see above) to a daily paper states that this discovery was made by a Prague professor (no name given) in 1885 who is said to have obtained an admirable photograph of Mt. Blanc at midnight, by the use of cathodic rays (there must be some mistake, for as understood from the meagre description of the discovery by Roentgen, it is not a true photographing process but a mere recording of a sort of shadow of a body which does not transmit certain rays, which, however, are not light rays; it is evident that no such shadow of Mt. Blanc would have been obtained); it is also stated that a full report of the achievement was made to the Austrian Academy of Science in 1885. The New York *Sun* states that Edison succeeded in making a plate some time ago, which would record that it had been near a warm body; also that Tesla had pointed out the actinic qualities of certain electric rays coming from phosphorescent light, with which he produced photographs (this also seems to refer to an entirely different matter). The *Elec. Eng.*, Jan. 22, contains an article by Mr. d'Infreville in which he mentions but does not describe a process of photographing in the darkness, which, however, seems to refer to an entirely different process.

The Roentgen discovery is also discussed editorially in *Electricity*, Jan. 22, in which some very decided statements are made. It has long been known, and is therefore no recent discovery, that certain opaque bodies are transparent to Hertzian waves which are etheric waves longer than those of light; it is thought that these waves have not yet been detected photographically; the chemically active rays in the physical spectrum are most numerous near the violet end; the actinism of light waves decreases rapidly as their lengths are increased; Hertzian and heat waves are very much longer even than the red rays of the spectrum, and, from present knowledge, one would be justified in saying that they are also non-actinic; Roentgen may have found a substance that will be chemically affected by these longer invisible radiations, and it is thought that the statement that he used ordinary photographic plates is exceedingly improbable, though not necessarily untrue; it is thought to be still uncertain that the action which silver undergoes on a photographic plate is chemical, as similar effects may be produced by pressure. He may have discovered some fluorescent substance capable of shortening the Herzian waves so as to make them photo-chemically active; it is known that conductive substances are opaque to Hertzian radiation and non-conductors are transparent to them; it is thought that the photography of the bones in the human body is a practical impossibility and that the transparency of aluminum of these plates is "the baldest fabrication"; it is also believed that lenses must have been used, but that they might have been of pitch, paraffine or ebonite; it is thought absolutely certain that he has not accomplished nearly as much as he is thought to have done. (The above argument assumes that the radiations are Hertzian waves, but the reports do not seem to show that this is necessarily the case.)

Magnetization of Iron by Weak Magnetizing Forces. Schmidt. *L'Eclairage Elec.*, Dec. 28, abstracted from *Wied. Ann.*, Vol. 54, p. 655.—The results of the researches of others not agreeing, he re-investigated the subject and determined the absolute values of the susceptibility for weak magnetizing forces; the zero method is adopted in connection with ellipsoids. He finds that for soft steel it is greater than for iron, in weak fields, in the ratio of about four to three, but after it has ceased being constant, it increases much faster for iron than for steel; the constancy of the susceptibility observed by Lord Rayleigh is verified up to fields from 0.03 to 0.04. This is followed by an abstract from the *Weid. Ann.*, page 602, of a paper by Mr. Culman replying to the previous one; he discusses the experimental results which seem to accord with the formula of Bauer and concludes that this formula has been verified only by the experiments of Lord Rayleigh on hard iron; the numbers obtained by Rossler and by Schmidt do not agree with the formula.

Temperature at which Iron Becomes Non-Magnetic. Grane. Lond. *Elec.*, Jan. 10; a brief abstract from the *Wied. Beiblaetter*, No. 11.—An iron wire was held by an electromagnet and heated by a current until it fell, the temperature being found by catching it in a calorimeter; he found that the temperature at which the change takes place is not constant; it increases with the strength of the magnet, varying between 735 degrees and 831 degrees C.; for nickel the figures are 368 degrees and 481 degrees C.

Multipolar Lifting Magnet. Elec. Eng., Jan. 15.—An illustrated description of a magnet for lifting purposes which adapts itself to the irregular surfaces of bodies to be lifted; it appears to be identical with the one described in the *Digest*, Dec. 14.

ELECTRO-CHEMISTRY AND BATTERIES.

Forming Accumulator Plates. Luckow. *Zeit. f. Electrochem.*, Jan. 5.—A long extract from his German patent to which special attention is

called editorially; it refers to an electrolytsic process of forming lead plates. He shows that in very dilute solution of salts the formation takes place much more rapidly for the same current; the forming current is of moderate strength and is passed continuously in one direction for about five days, after which the plates are finished; as an electrolyte he uses very dilute, slightly acid, neutral, or slightly alkaline solutions, containing a definite amount of any of certain salts; among the latter are the salts of all the light metals and of ammonia, the electrolysis of which produces no decomposition products on the positive electrode which would prevent or interfere with the formation of peroxide, as for instance some salts of organic acids, the sulphides, the sulphites and the nitrites; the double salts of the light metals among each other and with ammonia, with the properties above mentioned; also those salts of the heavy metals, their double salts either among each other or with those of the light metals and ammonia, with the above-mentioned properties and with which a deposit of metal on the negative pole either does not take place at all or can be prevented by a slight addition of free acid; by light metals he means those whose oxides are heavier than the elements themselves, and by heavy metals, those whose oxides are lighter than the elements. He points out the advantages of this method over the well-known rapid processes, particularly those in which nitric or acetic acid is used, with which the deposit is not sufficiently adherent; another advantage lies in the fact that the salts in solution are not decomposed and therefore not consumed, and the process is therefore cheap; peroxide is said to adhere very well to the plates and that it has a capacity, which, according to careful measurements, is from 3 to 5 times as great as that of the peroxide formed by the usual process. The formation is satisfactory only when the electrolyte is weakly alkaline or acid, or is neutral, and more especially only when it contains a certain percentage of the salt; if the acidity or alkalinity are greater, or the percentage of salt greater or less, the deposit will be very unsatisfactory; the limitations are said to be sharply defined, but when the proper proportions are used a surprisingly good effect is produced; the specific proportion of salt is between 1 and 3 per cent. of the salt free from water, depending on the particular salt used (but what the exact proportions are, is not given for any one of the salts); the peroxidation can be continued to any desired degree, even until the plates are entirely consumed.

Storage-Battery Development. EPSTEIN. Lond. *Elec. Rev.*, Jan. 10.—He refers to the recent paper read before the American Institute of Electrical Engineers, by Hering, and endeavors to show that all the recommendations made therein have been anticipated and removed from the field of speculation to the more substantial basis of actual work, and that most of the points recommended have already been embodied in the Epstein accumulators, which have been in the market for several years; the method which was suggested as an ideal had suggested itself to Epstein more than five years ago, and the plate constructed on those principles have met with complete success, sometimes under the most severe conditions. The Epstein plate consists of a vertical web with an equal number of horizontal ribs on both sides, the active material being produced from the plate itself by means of his chemical and electrical process. He refers to some tests (see Digest, Feb. 23, 1895), in which the cells after standing idle for three months, were found to have retained 80 per cent. of their original capacity; Mr. Swinburn remarked that the voltage keeps almost absolutely constant until the cell is entirely discharged; plates which have been in daily use for two years were found to look like new and to have their full capacity. The view expressed in the former paper that the only batteries which have an outlook for traction work are those which have a very large surface, and very small depth of active material formed electrolytically, he says can be fully endorsed, although he takes exception to the remedy suggested for retaining the effectiveness of the positive plates by replacing them from time to time; his positive plates have on a very trying road made more than 12,000 car miles, without any repairs or renewals; he approves of using batteries of small capacity for a few trips in preference to heavier batteries for a greater number of trips; they can be discharged with good efficiency in one hour, and even less; the increase in the total weight of a car with a full complement of passengers as compared with one driven on the trolley system need not be more than 3 per cent.

Electrolytic Amalgams. ANDREOLI. *L'Elec.*, Jan. 11.—The beginning of a series of articles; the present portion is introductory, and refers chiefly to the uses of sodium amalgam in metallurgy in place of mercury.

Calcium Chromite. Zeit. f. Electrochem., Jan. 5.—According to DUFEAU neutral calcium-chromite is obtained by heating 115 g. of chromic oxide with 45 g. of chalk in an electric furnace, with 700 amperes at 50 volts; it has a green color, is transparent and resists the action of the strongest acids. The note is taken from *Comptes Rendus*, Vol. 121, p. 689, where further information can probably be obtained.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Protecting Physical Institutes Against Disturbances by Electric Railways. FROELICH. Lond. *Elec.*, Jan. 10.—A translation in abstract of the paper noticed in the Digest, Dec. 14; some of the illustrations are reproduced.

Pyrometry. HOLMAN. *Tech. Quart.*, October.—He describes a proposed method of calibrating the Le Chatelier thermoelectric pyrometer, which requires only two known temperatures instead of several, thus saving labor and gaining accuracy; the method involves the use of a logarithmic instead of a direct plot. In conclusion he remarks that the thermoelectric method is by far the most promising one for an industrial pyrometer, as well as for scientific research, and he considers the Le Chatelier form of instrument as the most satisfactory one now obtainable in the market; if a galvanometer as convenient as the Weston voltmeter should be adapted, with a rhodo-platinum thermo-couple, it would form a most ideal pyrometer for technical work.

Electric Measurements. PARKER. *Elec. Power*, January.—The beginning of what appears will be a long serial, in which he endeavors to give a systematic treatise on the subject.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Time Telegraphy. WEST. *Elek. Zeit.*, Jan. 2.—A well-illustrated description of the system used at the Krupp factory at Essen.

Avoiding Side Tones in Telephone Transmitters. SCRIBNER'S method. *Elec. Eng.*, Jan. 22.—There are two primary coils connected in parallel with the microphone, the secondaries of each being connected in series with the line, while the telephone is placed in branch circuit in parallel with one of them; the currents in these two secondaries are in the same direction with respect to the line circuit; the mutual inductions between the primary and secondary of the two coils are adjusted so that with a given line resistance no difference of potential exists between the terminals of the secondary, which is connected as a shunt to the telephone, under which condition no current will flow through the telephone, and hence no side tone will be produced therein; this coil produces no useful current, but contributes only sufficient E. M. F. to overcome its own resistance, enabling the other to impress its full E. M. F. on the line; the former is given high impedance to prevent any large portion of the telephone currents from being shunted through it.

Automatic Telephone Exchange System. E. P. THOMPSON and DECKER. *Elec. Power*, January.—They give descriptions, with illustrations, of the various systems which have been devised, showing the present state of the art; the operation of each system is briefly described, but no comparisons are made.

MISCELLANEOUS.

Globular Lightning. SOUTER. Lond. *Elec.*, Jan. 10. Abstracted from *Wied. Beiblaetter*, No. 11.—After considering a large number of authentic cases he concludes that these globes are masses of incandescent gas which move slowly and often exist for several minutes, sometimes disappearing silently and sometimes with an explosion and mechanical destruction accompanied by electric shocks; a reproduction in the laboratory has not yet been successfully accomplished, although Planté and Von Lepel obtained small gobules conveying the discharge between two plates covered with moist tissue paper.

Review of the Past Year. Elec. Zeit., Jan. 2.—The summary of the work done by each of the leading German electrical companies, which is published by that journal yearly. In an editorial reference it is stated that no very important technical progress has been made, nor any new inventions opening up entirely new fields; the three-phase current system has been introduced largely during the past year; great progress is being made in the introduction of electric railways, and prospects of good work have been opened by the project of substituting electricity for steam on some of the shorter steam railways in South Germany. Great complaint is being made by all the companies of the very low prevailing prices and the increasing number of inefficient electricians.

Patent Laws in Japan. Zeit. f. Elek., Jan. 1.—A new law has recently gone into effect in Japan. A foreigner can obtain a patent only in the name of a native representative; it may be granted for 5, 10 and 15 years, and only for inventions which were not previously known to the patent office of that country, or have not been in use; the patent is granted to the one first making application for it; the importation of patented articles from foreign countries is forbidden; all articles patented in that country must be manufactured in Japan within two years of the date of the patent.

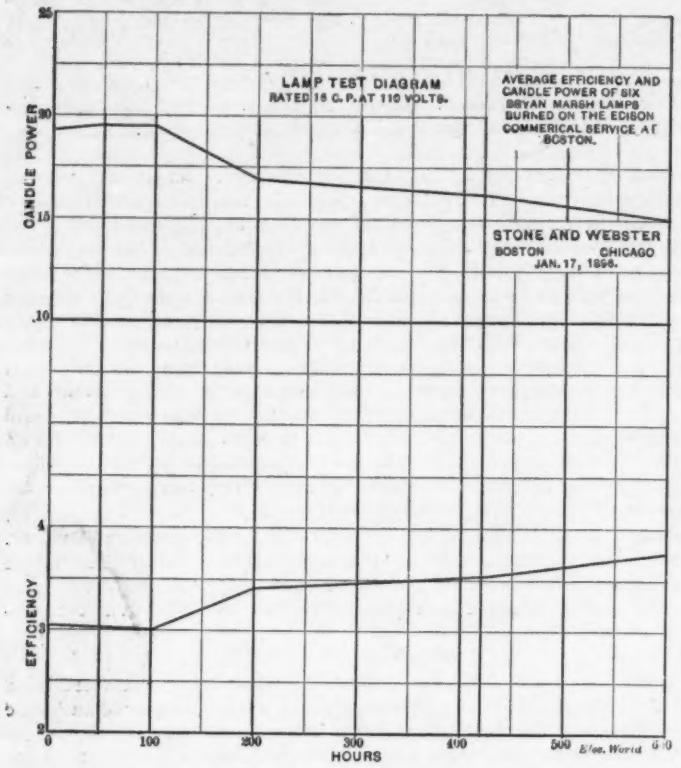
Biographical. Elec. Jour., Jan. 15.—A full-page portrait of James Prescott Joule.

Test of an American Incandescent Lamp.

We are able to present this week the rather remarkable results of a test on incandescent lamps of high economy conducted at the laboratory of Messrs. Stone & Webster, in Boston. The accompanying plotted curve comprise the average values on six lamps at different periods extending over 600 hours' burning. The standards were checked with a Methven burner, and the reading on each lamp was the result of fourteen settings. The lamps were tested on the commercial circuit of the Edison Illuminating Company of Boston.

They were run at a somewhat higher efficiency than is usual, and that the result should show such a constancy in the maintained candle-power, total watts and watts per candle, when the temperature of the filament was continued at such a high degree, is most noteworthy. The aim of many investigators and manufacturers is to produce a lamp of practically constant illumination after the initial fall, and it will be seen that those

under consideration dropped less than 2 candles during the final 400 hours of the test, finishing the run at an average slightly exceeding 15 candle-power. These conclusions, when considered in connection with the initial efficiency of 3.03 watts, an average efficiency slightly less than 3.5 watts, and the final efficiency of 3.76 watts per candle, show an average life economy in excess of results heretofore obtained from even 3.5 watt-lamps at a like voltage, and, if generally secured in practice, will go far toward rendering economies of great value to central stations, if under conditions of fairly maintained pressure, such as we presume prevailed during the test under consideration.



Curves of Lamp Tests.

Detailed examination of the action of the individual lamps show as considerable variation in both light and efficiency during the first 50 hours (which would indicate that they were regular commercial lamps, and not carefully selected); but, from that point until the close of the run the uniformity is excellent—a difficult achievement with lamps run at such a temperature. It is to be regretted that the test was not continued upward of a 1000 hours, for the lamps remained in excellent condition, with the exception of one death, and should have been safely over the 1000-hour line before the arrival of the "smashing point." We are glad to announce that the lamps tested are the product of an American factory, being the "Imperial" lamp made by the Bryan-Marsh Company.

Theatre Electric Railway Cars.

On Saturday of last week two new theatre parlor cars of the Brooklyn Heights Railway Company were run over the line for the first time with a party of newspaper men and the officials of the railway company. The two cars are called the "Montauk" and "Amphion," the names of two Brooklyn theatres. The cars will be chartered for private theatre parties, sight-seeing trips about the city, luncheons or long trips into the country. Arrangements have been made with the other companies operating trolley cars in Brooklyn to allow these cars to run over their lines, so that it will be possible to go to any point in and around the city. It is expected that the cars will be popular for carrying skating parties to Prospect Park and other places. They may be hired for an hour or a day, the cost being from $20 upward.

The cars, which were built by the Barney & Smith Car Company, of Dayton, O., are 25 feet long over the body and 36 feet long over the platforms, the width over the main panels is 7 feet 9 inches, and the height from the bottom of the sill to the top of the roof is 8 feet 6 inches. The platforms are enclosed with railings with bronze trimmings, and with solid bronze posts supporting the hoods. The windows of the cars are furnished with plate glass and the inside is of St. Jago mahogany handsomely carved and finished in oil. The windows are supplied with Burgess tapestry curtains, with Burrowes automatic fixtures and furnished with silk velour draperies of the most artistic design. In each of the four corners of the car there is a buffet with lockers above and below. The doors in the upper lockers are furnished with beveled plate glass mirrors. The doors of the car are of the double automatic pattern at each end. There are three incandescent electric chandeliers in each car with an incandescent goose-neck bracket over each buffet. The cars are heated by electric heaters under the seats. The hand straps are carried on bronze hand-rods, supported on solid bronze brackets. The seating is of loose wicker chairs, and so made that the cars cannot be marred, as all points that are liable to come in contact with the sides of the car are handsomely upholstered. The floor is covered with the Bigelow Wilton carpet. Each car is also supplied with two tables, which may be attached

Interior of Trolley Theatre Car.

to the sides of the car at different places. The cars are painted a Marseilles royal blue and ornamented in gold leaf. In addition to the seating capacity above mentioned, each car is supplied with 12 camp stools for use on the platform if desired.

Electrolysis from Electric Railway Return Currents.

An article appeared in the Pittsburg *Leader* of Jan. 13, stating that the underground cables in extensive districts of that city and its suburbs have been destroyed by electrolysis, and that underground pipes had also suffered from the same cause.

While it is true that gas pipes and cables in Pittsburg and other cities have been destroyed by electrolytic action, at the present time there are several well-known means by which destructive electrolytic action can be prevented. The cables in Pittsburg which suffered most from electrolysis were laid from six to ten years ago in wooden boxes filled with pitch, and it is well known that cables laid in this manner are more subject to electrolysis than those laid in a good duct system. The cables which have been laid in the ducts in Pittsburg are giving perfect satisfaction, and electrical tests show that there is no immediate danger of their being destroyed by electrolytic action.

Since cables and water pipes began to be destroyed by the return currents of the electric railways, much experimenting has been done by electrical experts to discover means to prevent the further destruction of underground pipes and cables. These early experiments proved that cables are only injured when the electric current flows from them to the earth through a moist medium, and that when the current goes from the earth to the cables there is no danger whatsoever of their being destroyed.

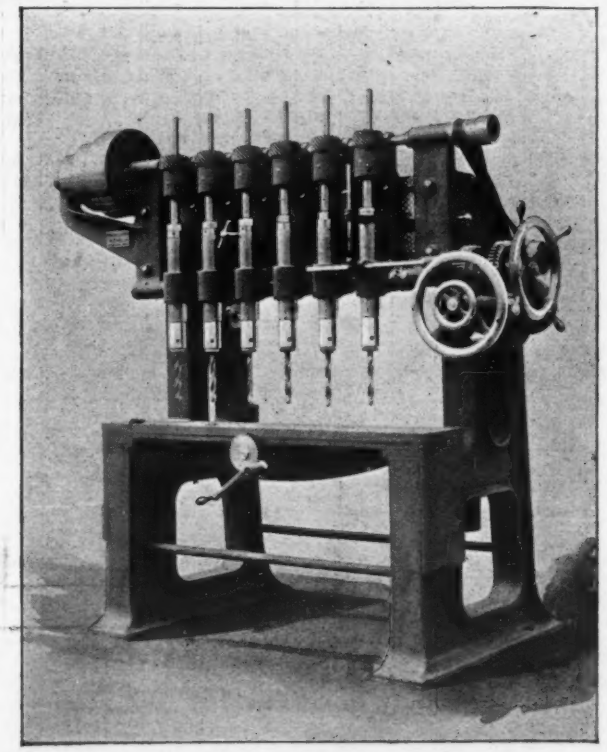
This investigation suggested at once the first remedy, which was to lay large copper wires parallel to the lead-covered cables and the electric railway, as a supplement to, and thoroughly connected with, the ordinary railway return system of rails and bond wire, and to connect the cables or water pipes by means of this supplementary return system, to the negative side of the dynamo of the electric railway company, the positive side of the dynamo being connected to the trolley. This enlarged return system, and the cables or water pipes connected thereto, serve as a means of collecting the electric current from the rails of the electric railway, and from the earth, and carrying it directly to the power-house. This plan has been adopted in a number of places, with most satisfactory results.

Another method for which still better results are claimed is to connect

the negative side of one dynamo in the power-house of the electric railways to the cables the negative sides of the other dynamo being connected to the rails and return feeder, and the positive side of all the dynamos to the trolley. The voltage of the one dynamo which is connected to the cables is always kept from 10 to 20 volts higher than that of the other dynamos, and this, practically speaking, prevents any of the current from flowing from the cable to the earth, and thus positively makes electrolytic action impossible. Wherever there is electrolysis, there is loss of power to the electric railway company. In one case, the amount lost in this way was claimed to be 20 per cent. of the total power used for propelling the cars, as shown by tests made before and after the method was adopted. From the standpoint of economy to the electric railway company, the same good results are obtained when the first-mentioned method is adopted; hence, everybody concerned is benefited by adopting these methods of preventing electrolytic action, and there is practically no danger of cables or water pipes being destroyed when these means are adopted.

Gang Drills.

We illustrate herewith a gang drill made by the Fitchburg Machine Works, Fitchburg, Mass., designed for the economical drilling simultaneously of a number of holes in the same line. The drills are adjustable transversely on the cross-beam shown, by means of pinions and a rack. The spindles, which are counterbalanced, are driven simultaneously and provided with adjustable collets, so that all the drills may be brought to work together. There is a friction feed with three changes, together with a hand feed by worm and worm wheels, and also a quick return for the spindles. A trip is provided for drilling to an accurate depth. The table is adjustable transversely by means of a crank. The maximum distance between the centres of any two drills is 6½ inches, and the minimum distance 4 inches; the maximum distance of the spindles from the table is 8 inches and the distance between the posts 44¾ inches. The speed of the spindles ranges from 150 to 400 revolutions per minute, and they will drill up to three-fourth-inch holes in steel.

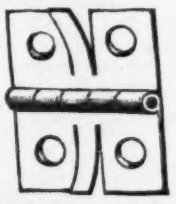


GANG DRILL.

A New Hinge for Telephone Boxes.

In no way is the state of an art more clearly indicated than by the minute attention given to details. An interesting example of this tendency toward perfection and simplification is furnished by the hinge for use upon telephone boxes shown in the accompanying illustration, and which is the invention of Mr. J. Brodie Smith, of the Brodie Electric Company, Manchester, N. H.

The telephone hinge usually employed heretofore consists of an ordinary hinge, to one side of which is fastened a small contact-preserving strip, which strip makes contact with the other half of the hinge when it is shut, thus reinforcing the conductivity of the circuit. In the hinge here illustrated the contact-preserving strips are part of the hinge itself, being formed out of the hinge by making two parallel saw-cuts into each side, and bending up slightly the portions between the saw-cuts so that they form a firm connection in the closed position, making an arrangement of extreme simplicity and ease of manufacture.



TELEPHONE HINGE.

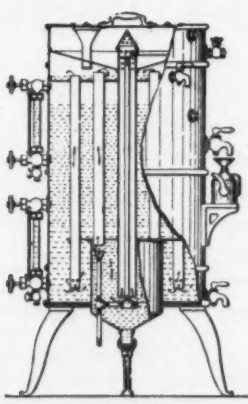
The Yale-Weston Chain Hoist.

The hoist which is the subject of the accompanying illustration, is claimed by the manufacturers, the Yale & Towne Manufacturing Company, Stamford, Conn., to be of high efficiency and requiring a minimum of power to be applied. In hand-power hoisting gear there is opportunity for much deception. It is enough for many men that the tackle runs easily and lifts the weight for which it is rated, no account being taken of the time in which this is done. Thus tackles with hoisting gear having excessive friction are made with a large reduction of motion, so that although the person hoisting does not have to pull very hard, yet he consumes an excessive amount of time. In order to be self-sustaining the method employed in many hoists is to have this friction so great that the load cannot overcome it and run down. This always entails a very low hoisting efficiency. The new triplex hoist illustrated utilizes an ingenious special device to prevent the load from falling when the chain is released. The friction of the block is thereby greatly reduced, and, as a result, a load can be lifted more rapidly with moderate effort.

Oil Purifier.

The oil purifier illustrated herewith, made by F. E. Bailey & Co., Betz Building, Philadelphia, is original in design, containing no filtering compound or material, such as felt, charcoal, ground cork, mineral wool, cloth, sponges, etc., any of which, it is claimed, soon become clogged and foul, and in a short time worse than useless.

The dirty oil to be purified is poured over the cone on top into the receiver, where coarse matter is arrested; it then passes down the large central tube, into the lower central compartment, where it is submitted to a gentle heat by steam-pipes and (these pipes having brass circulating tubes inside so as not to become hot-air bound,) thus causing the particles to separate and precipitate to the bottom the heavier matter, such as dirt or grit, held in suspension. The oil, after being thinned and lightened, passes up tubes, which extend through the top of lower settling compartments a short distance to prevent particles lighter than oil, such as sawdust, waste, etc., from passing up, which might do great damage to machine bearings. The oil passing up overflows upon the bottom of the second settling compartment, where it spreads out over a large area and permits a further settling, the upper strata of oil overflowing the tops of the tubes, which are slightly shorter than the inflowing ones, or extend through the bottom of the compartment.



OIL FILTER.

The oil then passes down the tubes and out at the small holes or lower ends, in small quantities, being washed through the lukewarm water in the space shown, drop by drop, making the oil clean and ready for use; it then passes above water line, into the storage space, where it accumulates for use. It is drawn off as needed through a cock, or may be conducted away by attaching a pipe at the screw-plug. New oil may be put in at the funnel, for purifying, as is sometimes necessary. A water-gauge designates the height of oil in tank, and the height of water.

CHAIN HOIST.

Table for Determining Sizes of Commutator Bars.

Mr. W. B. Cleveland, general manager of the Forest City Electrical Works, of Cleveland, O., has constructed from data compiled by him a chart entitled "Divisions of Commutators," which is intended for the use of electrical engineers, designers of dynamos and repair men. The chart, which we reproduce herewith in the form of a table, enables the degree and angle-chord to be determined for commutators of from 4 to 375 divisions of bars. The chords show the increase per inch in thickness of commutator bars of various angles, and are also the thicknesses of a division of a commutator of one inch radius, including the mica.

To obtain the thickness of a bar from a drawing, it is merely necessary to multiply the chord corresponding to the number of divisions by the radius of the commutator, and then deduct the thickness of the mica to be used. For estimating the weight of the bars thus determined it may be noted that copper is about 20 times the weight of a light soft-wood pattern.

DIVISIONS OF COMMUTATORS.

Div.	Angle	Chord.	Div.	Angle	Chord.	Div.	Angle	Chord.	Div.	Angle	Chord.	Div.	Angle	Chord.	Div.	Angle	Chord.	Div.	Angle	Chord.	Div.	Angle	Chord.	Div.	Angle	Chord.	Div.	Angle	Chord.	Div.	Angle	Chord.	Div.	Angle	Chord.
				° ′			° ′			° ′			° ′			° ′						° ′															
			26	13 51	.2411	51	7 03	.1231	76	4 44	.0826	101	3 34	.0622	126	2 51	.0497	151	2 23	.0416	176		.0356	201	1 47	.0311	226		.0277	251	1 26	.0250	276		.0228	301		.0208	326		.0193	351		
																						° ′																		° ′			
			27	13 20	.2322	52	6 55	.1208	77	4 41	.0815	102	3 32	.0615	127	2 50	.0494	152	2 22	.0413	177		2 02 .0355	202		.0309	227		1 35 .0276	252		.0249	277		1 18 .0227	302		.0207	327		1 06 .0192	352		.0178
			28	12 51	.2236	53	6 47	.1185	78	4 37	.0805	103	3 30	.0610	128	2 49	.0490	153	2 21	.0410	178		.0353	203	1 46	.0308	228		.0275	253		.0248	278		.0226	303			328			353		
	°																																							° ′		
4	90	1.4142	29	12 25	.2162	54	6 40	.1163	79	4 33	.0795	104	3 28	.0604	129	2 47	.0486	154	2 20	.0407	179		2 01 .0352	204		.0306	229		.0274	254	1 25	.0247	279		.0225	304	1 11	.0206	329		.0191	354	1 01	.0177
5	72	1.1756	30	12	.2091	55	6 33	.1142	80	4 30	.0785	105	3 26	.0598	130	2 46	.0483	155	2 19	.0404	180	2	.0349	205	1 45	.0305	230	1 34	.0273	255	.0246	280	1 17	.0224	305		.0205	330		.0190	355		
6	60	1.0000	31	11 34	.2022	56	6 26	.1122	81	4 27	.0775	106	3 24	.0592	131	2 45	.0480	156	2 18	.0401	181	1 59	.0346	206		.0303	231		.0272	256	.0245	281		.0223	306			331			356		
7	51 26	.8678	32	11 15	.1960	57	6 19	.1102	82	4 23	.0766	107	3 22	.0587	132	2 44	.0476	157	2 17	.0398	182	1 58	.0343	207	1 44	.0302	232	1 33	.0271	257	1 24 .0244	282		.0222	307		.0204	332	1 05	.0189	357		.0176
8	45	.7654	33	10 55	.1902	58	6 12	.1083	83	4 20	.0756	108	3 20	.0582	133	2 42	.0471	158	2 16	.0395	183		.0341	208		.0301	233		.0270	258	.0243	283		.0221	308	1 10	.0203	333			358		
9	40	.6840	34	10 35	.1844	59	6 06	.1064	84	4 17	.0748	109	3 18	.0577	134	2 41	.0468	159	2 15	.0393	184	1 57	.0340	209	1 43	.0299	234	1 32	.0268	259	.0242	284	1 16	.0221	309			334		.0188	359		
10	36	.6180	35	10 17	.1792	60	6	.1047	85	4 14	.0739	110	3 16	.0572	135	2 40	.0465	160	2 15	.0392	185		.0338	210		.0297	235		.0267	260	1 23 .0241	285		.0220	310		.0202	335			360	1	.0175
11	32 44	.5636	36	10	.1743	61	5 54	.1029	86	4 11	.0730	111	3 15	.0567	136	2 39	.0462	161	2 14	.0389	186	1 56	.0337	211	1 42	.0296	236		.0266	261	.0240	286		.0219	311		.0201	336		.0187	361		
12	30	.5176	37	9 44	.1694	62	5 48	.1012	87	4 08	.0722	112	3 13	.0561	137	2 38	.0459	162	2 13	.0387	187	1 55	.0334	212		.0295	237	1 31	.0265	262	.0239	287		.0218	312			337	1 04	.0186	362		.0173
13	27 42	.4788	38	9 28	.1653	63	5 43	.0997	88	4 05	.0715	113	3 12	.0556	138	2 36	.0455	163	2 12	.0384	188		.0333	213	1 41	.0294	238		.0264	263	1 22 .0238	288	1 15	.0218	313	1 09	.0200	338			363		
14	25 43	.4451	39	9 14	.1611	64	5 37	.0980	89	4 02	.0706	114	3 10	.0551	139	2 35	.0451	164	2 11	.0382	189	1 54	.0332	214		.0293	239		.0263	264	.0237	289		.0217	314			339		.0185	364		.0172
15	24	.4158	40	9	.1369	65	5 32	.0966	90	4	.0699	115	3 08	.0546	140	2 34	.0448	165	2 11	.0381	190		.0330	215		.0292	240	1 30	.0262	265	.0236	290		.0216	315		.0199	340			365		
16	22 30	.3902	41	8 47	.1532	66	5 27	.0952	91	3 57	.0690	116	3 06	.0542	141	2 33	.0445	166	2 10	.0378	191	1 53	.0328	216	1 40	.0291	241		.0261	266	1 21 .0235	291		.0216	316			341		.0184	366	0 59	.0171
17	21 11	.3674	42	8 34	.1495	67	5 22	.0937	92	3 55	.0683	117	3 05	.0538	142	2 32	.0442	167	2 09	.0376	192		.0326	217		.0289	242	1 29	.0259	267	.0234	292		1 14 .0215	317		1 08 .0198	342			367		
18	20	.3473	43	8 22	.1461	68	5 18	.0923	93	3 52	.0675	118	3 03	.0534	143	2 31	.0439	168	2 09	.0375	193	1 52	.0325	218	1 39	.0288	243		.0258	268	.0234	293		.0214	318			343	1 03	.0183	368		.0170
19	18 57	.3291	44	8 11	.1427	69	5 13	.0910	94	3 50	.0668	119	3 02	.0529	144	2 30	.0436	169	2 08	.0372	194	1 51	.0323	219		.0286	244		.0257	269	.0233	294		.0213	319		.0197	344			369		
20	18	.3129	45	8	.1395	70	5 08	.0897	95	3 47	.0661	120	3	.0524	145	2 29	.0433	170	2 07	.0369	195		.0321	220	1 38	.0285	245	1 28	.0256	270	1 20 .0233	295		.0213	320			345		.0182	370		.0169
21	17 09	.2980	46	7 49	.1364	71	5 04	.0884	96	3 45	.0654	121	2 58	.0520	146	2 28	.0430	171	2 06	.0367	196	1 50	.0320	221		.0283	246		.0255	271	.0232	296	1 13	.0212	321		.0196	346		.0181	371		
22	16 23	.2850	47	7 40	.1335	72	5	.0872	97	3 43	.0647	122	2 57	.0515	147	2 27	.0427	172	2 06	.0365	197		.0318	222	1 37	.0282	247		.0254	272	.0231	297		.0211	322	1 07	.0195	347			372	0 58	.0168
23	15 39	.2723	48	7 30	.1308	73	4 56	.0861	98	3 40	.0640	123	2 56	.0510	148	2 26	.0425	173	2 05	.0363	198	1 49	.0317	223		.0281	248	1 27	.0253	273	1 19 .0230	298		.0210	323			348	1 02	.0180	373		
24	15	.2611	49	7 21	.1282	74	4 52	.0849	99	3 38	.0634	124	2 54	.0505	149	2 25	.0422	174	2 04	.0361	199		.0315	224		.0280	249		.0252	274	.0229	299		0210	324		.0194	349			374		
25	14 24	.2507	50	7 12	.1256	75	4 48	.0838	100	3 36	.0628	125	2 53	.0501	150	2 24	.0419	175	2 03	.0358	200	1 48	.0314	225	1 36	.0279	250		.0251	275	.0228	300	1 12	.0209	325			350		.0179	375		.0167

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Jan. 25, 1896.

AMERICAN BELL remained practically steady at 198 all the week, in spite of one or two minor bear attacks. A prominent friend of the Bell stock in Boston has expressed the opinion that when the present contract between the American Bell Company and the Western Union Company expires, some friendly arrrangement will be made, notwithstanding reports concerning prospective competition with the Western Union by the Bell Company in telegraph work. Under the present arrrangement between the companies, the Bell Company pays the Western Union Company 20 per cent. of the rentals from all instruments outstanding. When this agreement was made the Western Union Company was in the telephone business and controlled a number of valuable patents. The payments under this agreement commenced in 1891, and up to date have aggregated $6,972,000.

WESTERN UNION has been subjected to a great deal of criticism by bears who are constantly referring to the poor showing which the company is expected to make for the current quarter. Those who profess to be posted express the opinion that the earnings are continually decreasing and in spite of the reduction in operating expenses the net results are very disappointing. Last year the deficit, after paying charges and dividends for the quarter ending March 31, was $235,400, and it is estimated that if the earnings this year are substantially the same as those of 1895, the deficit for the current quarter will be in the neighborhood of $250,000; upon this hypothesis the surplus of the company for the nine months of the fiscal year, after paying dividends, would be $421,652, or less than one half of one per cent. on the capital stock outstanding.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	92	95
" " " Brooklyn	100	110	115
" " " Boston	100	145	150
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	26	..
Electric Storage, pref	100	26½	..
General Electric	100	26¾	26⅞
General Electric, pref	100	60	63
Westinghouse Consolidated, com	50	30	31
" " pref	50	54	54½

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	197	198
American District Telegraph	100	33	40
American Telegraph & Cable	100	..	93
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
Erie Telephone	100	61	61½
Gold & Stock Telegraph	100	105	..
New England Telephone	100	86	87
Postal Telegraph-Cable	100	82	83
Western Union Telegraph	100	84¼	84½

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	16⅞	17¼
Binghamton RR. com	100	100	..
Brooklyn Traction	100	8	10
" " pref	100	47	52
Buffalo St. Ry	100	74	78
Cleveland Electric Ry	100	59	60¾
Columbus St. Ry	100	47	51
Hestonville	100	47	..
Long Island Traction, all pd	100	19¾	20
New Orleans Traction	100	16	18
" " pref	100	64	67
North Shore Traction	100	27	31
" " pref	100	78	82
Rochester St. Ry	..	25	30
Steinway, Ry	..	50	..
Union Ry. (Huckleberry)	100	112	115
Union Traction, rcts $5 pd	..	10¾	11⅛
West End, Boston	100	66	66½
" " pref	100	93	..
Worcester Traction	100	11½	13
" " pref	100	82	84

BONDS.

Buffalo St. Ry. 1st con. 5s	100	102	104
*Binghamton Railway Co. 5s	100	99	100
Cleveland Elec. Ry. 1st mtge 5s	100	100	103
*Columbus St. Ry. 1st 5s	100	98	101
Rochester St. Ry. 1st 5s	100	102½	104
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.

EDISON ILLUMINATING of New York reports gross earnings for December, 1895, of $200,745.58, an increase of $4,655.75 over the same month of 1894. The net earnings are reported as being $107,285.35, against $95,598.60 for December, 1894, showing $7031 greater net increase than gross increase, which means, of course, a substantial reduction in expense account. The gross earnings for the whole year are reported at $1,859,721.91, an increase of $170,347.63 over 1894. The net earnings for the year are $915,758.74, against $789,466.58 for 1894.

THE TRACTION MARKET, in sympathy with the general list of industrials, has been exceedingly dull this week.

BUFFALO RAILWAY stock did not show the expected advance upon the publication of the decision of the Railway Commissioners denying the application of the Buffalo Traction for a certificate of "necessity and convenience." Recent activity in the stock seems to have almost entirely subsided, indicating that the effect of the decision was discounted.

BROOKLYN CITY AND BROOKLYN TRACTION both show an inclination toward weakness and dullness after last week's activity and strength. It is probably due to some extent to the general dullness prevailing, but it is also attributed to a desire among investors to hold off until next week, when it is said that the terms of the Brooklyn Traction-Nassau Electric lease will be made public. The introduction last week in Albany of a bill levying a tax of three per cent. on the gross receipts of all the Brooklyn roads is also considered to have interfered with trading. This bill if made a law would affect all the Brooklyn roads excepting the Nassau, which already pays three per cent. to the city under the terms of its franchise.

THE BROOKLYN RAPID TRANSIT COMPANY, which was incorporated last week with a capital of $20,000,000, succeeds the Long Island Traction Company in the control of the Brooklyn City, Brooklyn Heights and Suburban Railways, being practically a reorganization of the former.

NEW ORLEANS TRACTION opened strong on Monday, 65 being paid for preferred stock; some small offerings and the general absence of buying orders broke the price, however, later on, and sales are reported around 62 to-day. The net earnings of the company for the month of December were $56,885, as compared with $49,407 for December, 1894.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Jan. 27, 1896.

THE PERKINS ELECTRIC SWITCH MANUFACTURING COMPANY, of Hartford, Conn., has appointed Mr. C. I. Hills manager of the selling department, with headquarters at 219 Havemeyer Building, New York City.

THE BROOKLYN BRIDGE LIGHTS.—Assemblymen Wilson will offer a bill to compel more electric lights on the roadway of the Brooklyn Bridge. It requires that the lights shall not be less than 30 candle-power, and not over 50 feet apart.

RAILWAY SENTRY BOXES.—The Board of Aldermen has given the Nassau Electric Railway Company authority under the direction of Supervisor of City Works to place temporary sentry boxes along its routes, for the protection of switch-tenders in stormy weather.

THE BOYNTON BICYCLE RAILWAY.—The application of the Kings, Queens & Suffolk Railway Company for permission to construct a line of railway on the Boynton bicycle system in Queens County has been refused by the State Railway Commissioners on the grounds that the company has not complied with the law in having 10 per cent. of its capital paid in in cash. In its opinion the commission also states that the proposed railway is so novel that there is room to seriously consider the question whether the statutes under which the applicant incorporates were intended to provide for such a system.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Jan. 25, 1896.

MR. JNO. P. COGHLIN, manager of the Columbia Electric Company, Worcester, Mass., was in Boston this week, and reports business for his company as still on the increase. Wide-awake and active, he don't usually "get left" in the business end.

MESSRS. PLUMMER & HAUR, of Worcester, Mass., electrical engineers and dealers in electrical supplies, have recently removed into their new and handsome store, 619 Main Street, which is attractive and spacious, and well stocked with the most varied assortment of electrical appliances of all kinds. Increased facilities are also manifest for electrical engineering and construction work.

THE ELECTRIC POTENTIAL dinner at the Quincy House last Tuesday evening reminded one of old times. It has been several years since there was

such a notable gathering of gentlemen representing the gas and electrical interests of New England, and expressions are general that the good work will be kept up. There is no reason now why this organization should not achieve most gratifying success.

HON. JOHN R. MURPHY, Commissioner of Wires, has resigned, and Alderman T. W. Flood has been appointed his successor, Mr. Murphy becoming Water Commissioner. Entirely a political deal, and while regrets are expressed over the retirement of Mr. Murphy, and congratulations and best wishes attend Mr. Flood, the electrical fraternity congratulates itself most over the fact that "old reliable" and popular Capt. Brophy remains as Assistant Commissioner of the wire department.

PRESIDENT W. W. GIBBS and General Manager Herbert Lloyd, of the Electric Storage Battery Company, Philadelphia, were Boston visitors this week. When Mr. Arthur E. Childs, New England manager, can attract the combined presence and influence of these two executives, it is safe to assume that there is some truth in the rumor that a very important New England contract for storage batteries is soon to be announced. Mr. Childs and his associates don't do business on the "brass band" order, but there is a "get there" all the time.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Jan. 24, 1896.

MR. J. A. J. SHULTZ, president of the Shultz Belting Company, of St. Louis, Mo., has been visiting Chicago for the past three days attending the National Manufacturers' Association Convention.

THE PHŒNIX TELEPHONE MANUFACTURING COMPANY, is now prepared to handle telephones and telephone equipments direct for central-station outfits. This company has the reputation of making exceptionally high class goods. It has at the present time a number of exchanges that are giving great satisfaction.

THE ELLIPTICAL CARBON COMPANY, the organization of which was completed in December, 1895, has for its object the manufacture and sale of elliptical carbons for all-night or double-service burning. The history of the various patents owned by this company would make very interesting reading to those unacquainted with the issuance of patents which are delayed by interfering applications, appeals from decisions, etc. It is sufficient to say, that it required four years to have the patents issued as applied for. The gentlemen composing the company were ready to organize as early as September, 1891, but were delayed from time to time awaiting Patent Office decisions favorable to their interests. It is the intention of the company to equip lamps of any manufacture with its elliptical carbon holders at a small cost for so doing. Several men, well known in electrical circles, are connected with the company, among whom are E. E. Crepin, G. A. Rollins, S. P. Parmly and Charles E. Gregory. For the present the general offices of the company will be at Suite 624, 205 La Salle Street, Chicago. E. E. Crepin is president and Charles E. Gregory manager.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Jan. 8, 1896.

A DEAF TELEPHONE SUBSCRIBER.—An interesting judgment was recently given in Glasgow, in connection with an action brought by the National Telephone Company against a resident of that "unco' guid" city. The Telephone Company demanded payment of £7.15—the rent of a private telephone wire, and also of a further sum of £10 for the rent of an exchange wire. The defendant was "somewhat hard of hearing," but this, he alleged, had been fully explained to the telephone company's canvasser, who had promised that instruments should be provided him which would meet the case. He said, however, that he was quite unable to make any use of the telephone supplied on this understanding, and therefore refused to pay for them. The court upheld the defendant's contention.

ELECTRIC HAULING EXPERIMENTS ON THE BURGUNDY CANAL.—Information has just come to hand of some interesting experiments, which have just been carried out on a selected section of the Burgundy Canal in France. Two modes of propulsion are being tried, either an electrically propelled iron boat is fixed to the sterns of the barges, or they are hauled by a motor secured to an arm, suspended from an overhead wire, in the manner recently adopted on the Niagara Canal. The Burgundy Canal is here 10 metres wide at the bottom, and 1.8 metres deep. The draught of the barge used when fully loaded was 1.5 metres. The current was supplied at a pressure of from 300 to 350 volts from a turbine-driven dynamo, the water used being that necessary to make good the loss in filtration. Using the iron boat fixed to the stern of the barge, a maximum speed of 3 kilometres per hour was obtained, with a load of 100 tons. With a load of 250 tons, a maximum speed of 2.4 kilometres was attained, the current varying from 12 to 14 amperes. The electric horse hauled two 200-ton barges at a speed of 2 kilometres per hour, the current varying from 10 to 12 amperes.

TRIALS OF THE ELECTRIC LIGHTING PLANT AT DOVER.—During last October a series of official trials on behalf of the electric lighting company at Dover was conducted by Profs. A. B. W. Kennedy and S. P. Thompson, on the alternate-current generating plant at the Dover electric light station. The report of these trials has recently been handed in, and the greater part of it has now been made public. At this station there are at present four direct-coupled generating sets, comprising one 50-kw, one 75-kw and two 100-kw Brush alternators directly connected to Brush vertical-compound steam engines. The combined efficiencies of these sets came out during the trial as follows: For the 50-kw set, 80 per cent.; for the 75-kw set, 81 per cent.; and for the 100-kw sets, 83.7 per cent.; at their full rated loads. The sets were specially tested at an output of 20 per cent. in excess of the full load, and are said to have run very satisfactorily. The steam consumption of the 100-kw sets measured at full load, and condensing, was found to be 22.8 pounds per electrical horse-power hour. For some time current has been supplied to the public from this station but the official opening has not yet taken place, but is expected to do so shortly.

CHEAP GLOW LAMPS.—For some time there have been mutterings in Germany about the distressing effect on the good repute of the electrical industry, which the advent of the new glow lamp is bringing about. As a result of this feeling a special committee of the representatives of the German electric supply companies was recently appointed to inquire into the matter, and their inquiries resulted in a report of an extremely severe character. The main recommendation of the report was that it would pay electric supply companies in Germany to give their customers well tested lamps for nothing. We in England view the possible adoption of this proposal with some little alarm. The advent of the cheap glow lamp in this country has also brought about results not dissimilar, though perhaps not quite so bad, to those of which the Germans complain. We feel sure that matters will be made considerably worse if censorship is exercised over the supply of glow lamps in that country, for bad glow lamps will no doubt continue to be made for export, and this country, owing to the absence of any protective tariff, will no doubt be inundated with what has been termed the "scum of German incandescent lamp factories." Already English manufacturers are complaining of the ingenious and unscrupulous imitation of their trade marks, etc., by Germans, and if the fraudulent lamp is prohibited in Germany, the tendency to force it upon the English market will be considerably increased. It is unnecessary to say that many of our lampmakers are taking advantage of this feeling of alarm to covertly introduce a protective tariff; not, of course, with a view of increasing the price of the glow lamp, and increasing their profit, but purely "pro bono publico."

DENVER NOTES.

DENVER, COL., Jan. 20, 1896.

EFFORTS ARE BEING MADE to introduce an electric light plant at Casper, Wyo. It is proposed to install the electrical machinery in the refinery at that place, which has sufficient power available for operating the dynamos.

THE GRIFFIN WHEEL COMPANY, whose factory in Denver was opened for work in November, is now turning out about 150 wheels daily, and it is probable the output will have to be increased to meet the demand. Wheels for electric cars, railway wheels and wheels for other purposes are made.

MAYOR McMURRAY of Denver has vetoed the ordinance which gave to the Denver Tramway Company the right to build an electric line to connect its Twenty-fifth Street line with the Stout Street Line. He believes, he states in his veto message, that the time has come when all franchises should be paid for and that all franchises should contain a provision for the ultimate municipal ownership of street railway tracks.

MANAGER FIELD recently said to the writer, "Colorado is, in my opinion, the most prosperous State in the Union. People have not begun to realize what has been accomplished and what is being accomplished here. There is the most wonderful demand for telephones and the only question with us is how we shall meet it." Mr. Field recently went East, presumably to consult some of those interested in the company as to the best means of raising funds for developing the business of the company.

THE MOUNTAIN ELECTRIC COMPANY has recently made an interesting sale, that of an electrolytic dynamo to W. S. Stratton of the famous Independence mine at Cripple Creek, from which $1,500,000 in gold was taken last year and in which the value of the ore in sight is estimated at from $2,000,000 to $5,000,000. It is said that the machine, the output of which is 2000 amperes at 20 volts, is to be used in connection with some process for treating low-grade ores. The same company has recently installed at Ward, Col., a three-phase plant of 100-hp for Col. Brainerd. The power is to be used for lighting and for operating a number of small motors. Motors will be used for developing prospects and it is claimed that the work can be performed much more economically than by means of a whim. The same company recently sold a 100-hp electric hoist to be used at the Grant mine in Aspen.

THE GENERAL ELECTRIC COMPANY'S Denver office has had a marked success in business, as shown by a recent statement of Manager Irving Hale. During the last six months he says business has increased to a marked extent. The general view that the same degree of prosperity as was experienced before the panic has not yet been reached, is not supported by the conditions which prevail in the electrical field. It is interesting to note that during the last nine months the Denver office of the General Electric Company has sold about seven times as much apparatus for electric light, power and mining purposes as during the corresponding period preceding the panic. The increase in business, says Mr. Hale, is largely due to the construction and extension of transmission systems. One of the comparatively recent sales of the office was that of four 400-kw three-phase generators to the Big Cottonwood Power Company, of Salt Lake City. Power is to be transmitted from the Big Cottonwood Creek to Salt Lake City, a distance of 14 miles. The current is ultimately to be used for lighting, for operating the electric cars and for general power purposes. The general manager and the prime mover in the enterprise is R. M. Jones, whose descriptions and views of the Big Cottonwood power scheme will be remembered by a great many persons whom he met during his visit in the East over two years ago. The Salt Lake & Ogden Gas & Electric Light Company has made a contract to take current from the Big Cottonwood Company, but, as the latter's plant is not yet ready to begin operations, it has ordered through the Denver office, as an increase to its plant, three three-phase machines, two of 150 kw, and one of 50 kw capacity. Among some of the other interesting orders are the following: Citizens' Electric Light Company, Salt Lake City, two 150-kw monocyclic alternating current generators; Caroline Mining Company, Ouray, Col., one 200-kw generator, increase of plant; Colorado Fuel & Iron Company, of Denver, one 100-kw direct-connected 500 volt generator, two 120-hp motors for pumping, two 15-hp motors for pumping, one 20-hp motor for blower, one 10-hp motor for machine shop; this machinery is to be used for mining purposes at Rause, Col.; Ontario Silver Mining Company, Park City, Utah, one 75-kw three-phase generator, and one 20-hp motor; increase in the lighting and power plants. The total cost of apparatus sold during the year, including freight, setting up and other electrical construction, but not including steam or water power or buildings, aggregated about $278,000.

General News.

NEW INCORPORATIONS.

THE CONSOLIDATED LIGHT, HEAT & POWER COMPANY, Olyphant, Pa., has been formed by Joseph H. Kelly, John F. Cummings and James J. Cummings, all of Olyphant, for the purpose of supplying electric light, heat and power. Capital stock, $12,000.

THE FALCONER MANUFACTURING COMPANY, Portland, Me., capital stock, $100,000, has been organized by William D. Craw, Newton, Mass; Burton Smith and A. C. Berry, Portland, Me., for the purpose of dealing in and manufacturing electrical and mechanical machinery.

THE TARRYTOWN ELECTRIC RAILWAY COMPANY, Tarrytown, N. Y., has been organized by Robert E. Hopkins, Robert Sewell, George B. Newton, and John D. Archibald, Tarrytown, N. Y., for the purpose of building an electric street railway. Capital stock, $50,000.

THE ROCKFORD TRACTION COMPANY, Chicago, Ill., capital stock, $300,000, has been incorporated by C. Harry Moore, Harry L. Jewell and William Foster Barns, for the purpose of constructing, operating and maintaining a system of street and highway railways.

THE MILWAUKEE, RACINE & KENOSHA RAILWAY COMPANY, Racine, Wis., has been formed by Thomas M. Kearney, C. M. Dietrich and R. T. Robinson, Racine, Wis., for the purpose of constructing an electric railway from Milwaukee to Racine and Kenosha. Capital stock, $100,000.

THE CROSHAW COMPANY, Kittery, Me., has been incorporated, with a capital stock of $100,000, for the purpose of manufacturing and dealing in electric lamps and electrical appliances. Those interested are Otis H. Shaw and Edward H. Crosby, Boston, Mass., and Chester Snow, Jr., Harwich, Mass.

THE GRAPHITE RHEOSTAT COMPANY, Chicago, has been incorporated with a capital stock of $5000 for the purpose of manufacturing, buying, selling and dealing in electrical apparatuses, appliances and machinery of all kinds. Those interested are John H. Miller, John H. McCurren and W. C. Adams.

THE PHILADELPHIA RURAL RAILWAY COMPANY, Philadelphia, Pa., capital stock, $100,000, has been incorporated for the purpose of building an electric railway in Delaware County. The promoters are Louis D. Erben St. Davids, Pa.; Edwin Burton Colket, Strafford, Pa., and Willis Terry, Philadelphia, Pa.

THE VIRGINIA ELECTRICAL ENGINEERING COMPANY, Roanoke, Va. capital stock, $10,000, has been incorporated for the purpose of contracting for and conducting electrical railways, appliances and fixtures. Those interested are William H. Trial, G. C. Callahan, R. J. Ringwalt and S. P. Wazard, Philadelphia, Pa.

THE BRAINERD TRACTION, LIGHT & POWER COMPANY, Chicago, Ill., has been formed by John C. Campbell, Edward S. Elliott and William Brace, to purchase, construct, own and operate street railways, electric light plants and power plants, gas works, telephone lines and water-power plants. Capital stock, $300,000.

THE BEST ELECTRIC LIGHT COMPANY, New York City, N. Y., has been incorporated for the purpose of building and operating conduits and electrical conduits in New York. Those interested are John O. Comack, Lester Doctor, Fred A. B. Jacobs, Louis M. Doctor and David J. Hamburger, New York City. Capital stock, $5000.

THE THOMAS DAY COMPANY, San Francisco, Cal., has been formed for the purpose of dealing in and manufacturing gas and electric fixtures, brass goods and plumbers' supplies. Those interested are Frank Symmes, Vanderlynn Stow, James Templeton, Edward J. Duffee, Edward H. Richardson, San Francisco, Cal. Capital stock, $300,000.

THE AUTOMATIC TELEPHONE COMPANY OF NIAGARA FALLS, Niagara Falls, N. Y., has been formed for the purpose of constructing, owning, using and maintaining an electric telephone line or lines. Those interested are Spencer J. Laurence, Gardner C. Clarke, W. R. Campbell and Walter P. Howe, Niagara Falls, N. Y. Capital stock, $75,000.

THE LEADVILLE LIGHT COMPANY, Leadville, Col., has been formed for the purpose of constructing an electric light plant, for furnishing the City of Leadville and the mines with light, etc. Those interested are George P. Brown, Charles Boettcher, Charles N. Priddy, John F. Campion and A. V. Hunter, Leadville, Col. Capital stock, $150,000.

THE STANDARD THERMOMETER & ELECTRIC COMPANY, Portland, Me., has been formed for the purpose of manufacturing and dealing in thermometers and in electrical and mechanical appliances. Those interested are Roger Upton, Concord, Mass.; Samuel L. Lord, Peabody, Mass., and Edgar W. Upton, Salem, Mass. Capital stock, $200,000.

THE MANSFIELD, SAVANNAH & WELLING ELECTRIC RAILWAY COMPANY, Mansfield, O., capital stock, $100,000, has been incorporated by Thomas Y. McCray, Zalmon S. Stocking, Nelson Ozier, B. F. Platt and Thomas B. Martin, for the purpose of constructing and operating an electric railway from Mansfield to Wellington, passing through Savannah, O.

THE FOREST CITY ELECTRIC COMPANY, Cleveland, O., capital stock, $25,000, has been incorporated by William B. Cleveland, Robert N. Lowe, Frank H. Neff, William H. Wherry and Walter C. Cleveland, for the purpose of buying, selling and manufacturing electrical apparatus, supplies, machinery, etc., and to construct heating, lighting and power plants.

THE ABBOTT ELECTRIC AIR COOLING & PURIFYING COMPANY, San Francisco, Cal., has been formed to manufacture all apparatus required for the purpose of placing the Abbott Electric Air Cooling & Purifying process in all structures. Those interested are H. W. Abbott, D. Gilbert Dexter, A. S. Brakett, Mark Strouse and H. C. Birlee, San Francisco, Cal. Capital stock, $1,000,000.

THE MILL VALLEY & MOUNT TAMALPAIS SCENIC RAILWAY, San Francisco, Cal., has been organized for the purpose of purchasing and constructing railways to be operated by steam, electricity, or other motive power, and to construct telegraph and telephone lines. The promoters are William C. Bole Fremery, Oakland; Arthur A. Martin, Charles E. Green, David McKay, San Francisco; Sidney B. Cushing, San Rafael, Cornelius Toohy and William C. Savage. Capital stock, $200,000.

TELEGRAPH AND TELEPHONE.

NEWPORT, ARK.—Newport will soon have a telephone system.

NASHVILLE, MICH.—Nashville will probably have a new telephone line in the near future

JANESVILLE, WIS.—A new telephone company is trying to secure a franchise in Janesville.

COUDERSPORT, PA.—A charter has been granted to the Coudersport Telephone Company.

BANDON, ORE.—Again the movement is being revived to build a telephone line from Bandon to Gold Beach.

ROWAYTON, CONN.—A scheme is on foot in Rowayton to start a local telephone exchange. Edward L. Stevens is at the head of the movement, and has the backing of several prominent residents.

TRENTON, N. J.—Supt. Drake of the Fire and Peace Telegraph and Telephone Department, claims to have invented a "step-down" coil, the introduction of which into telephone lines does away completely with buzzing sounds.

ELECTRIC LIGHT AND POWER.

ELLWOOD, IND.—The citizens are petitioning for additional electric lights.

TOMAHAWK, WIS.—The Council is considering the question of municipal lighting.

COLUSA, CAL.—A municipal lighting plant is being considered by the Council.

WEST CHESTER, PA.—A borough electric light plant is being talked of in West Chester.

CRIPPLE CREEK, COL.—The Council has under consideration the question of municipal lighting.

PORTLAND, ORE.—The Portland *Oregonian* is advocating municipal ownership of the lighting plant.

PIERCETOWN, IND.—Lipps & Noble are reported to have petitioned the City Council for an electric light franchise.

BUFFALO, N. Y.—The Buffalo & Niagara Electric Light Company has increased its capital stock from $100,000 to $200,000.

CHATHAM, VA.—W. J. Overbey desires information and estimates on an electric light plant for a town of 1000 inhabitants.

ROCKFORD, ILL.—Sealed proposals will be received for the furnishing of city lights for a term of five years, from July 1 next.

TEWKSBURY, MASS.—The management of the Tewksbury almshouse has recommended the extension of the electric plant.

ARKADELPHIA, ARK.—The Arkadelphia Light & Power Company's power-house has been destroyed by fire at a loss of $60,000.

ELLWOOD CITY, PA.—The Council of Ellwood City has passed an ordinance for electric lighting over Burgess Northwood's veto.

AUBURN, ALA.—Address the mayor concerning construction of an electric light plant, for which a company is now being formed.

RICHMOND, VA.—The residents of Chestnut Hill and Highland Park are contemplating the erection of an electric plant and manufactory.

KENOSHA, WIS.—The Kenosha Electric Light Company has filed articles of dissolution and distribution of property with the Secretary of State.

PALO ALTO, CAL.—Palo Alto citizens will vote at the coming election upon increasing the debt to $15,000 to provide electric street lights and new sewers.

NEW CASTLE, COL.—The city clerk can give information concerning the establishment of an electric light plant. It is to be constructed at a cost not to exceed $6000.

PECKVILLE, PA.—The citizens will determine by vote at the coming Spring election whether or not they are willing to have a levy of eight mills more to light the borough.

WAPELLO, IA.—W. H. Prescott has applied for a franchise for an electric light plant, and desires to receive prices on a 1200-light alternator and 100-hp engine and boiler.

FLUSHING, L. I.—With Broadway and Main Street lighted by arc electric lights in operation since Jan. 1, citizens are clamoring for an extension of the system to other streets.

HOBOKEN, N. J.—The new $60,000 public library building will have electric lights, and bids are now being asked for electric wiring. Thomas F. Hatfield, librarian, may be addressed for particulars.

CRESCO, IA.—The petition of Charles E. Speed, of McGregor, for a permit to erect poles and string wires, for the purpose of maintaining an electric light and power plant in Cresco, has been granted.

BUCHANAN, MICH.—A special election on the proposition to bond the town for $25,000 for the purchase of an electric lighting plant resulted in the defeat of the proposition by a vote of 176 to 979.

TRENTON, MO.—The electric light plant has been purchased by the Moberly Estate. It is understood that the new management will improve the plant at once and put it in a first-class condition.

CARDINGTON, O.—The electric light plant of this place has been totally destroyed by fire. Loss, $3500. The plant was owned and operated by the Cleveland Electric Light Construction Company.

SCHRAALENBERGH, N. J.—An electric light plant will be installed during the coming Spring. Information may be obtained by writing to C. B. Schuyler, 405 West Forty-second Street, New York.

RANDOLPH, MASS.—The Randolph Electric Light Company is increasing its steam plant by the addition of a 100-hp tandem compound condensing engine of the Bell Engine Company, Erie, Pa., manufacture.

MADISON, WIS.—The Common Council took the first step toward municipal ownership of its electric lighting by passing a resolution for the appointment of a committee to investigate and report on the subject.

GAINESVILLE, FLA.—The ordinance granting a franchise to James M. Graham, H. E. Taylor and F. W. Cole for an electric light and power plant was called up from the Ordinance Committee and placed upon its first reading.

WHITESTONE, L. I., N. Y.—The Whitestone Improvement Association has now taken up the lighting question. The idea is to issue 10-year bonds for $1500 for the purpose of providing electric lights for the entire village.

DULUTH, MINN.—A. C Bachelor, a stockholder in the Tower Electric Light Company, has made application for the appointment of a receiver, alleging that George H. Claypool and E. C. Jones have been wrecking the company.

PORTLAND, CONN.—It has been officially stated that the charter of the insolvent electric light company of this place is practically controlled by the Connecticut Engineering Company, of Norwich, and that it will soon be sold to the highest bidder.

BALTIMORE, MD.—Henry T. Douglass, president of the Baltimore & Catonsville Construction Company, can give information concerning a contract which is about to be let for condensing machinery and electrical equipment for two power-houses.

NIAGARA FALLS, N. Y.—The Niagara Falls Power Company has accepted the franchise offered by the City of Buffalo, and steps will be taken to get current to the latter place as soon as possible. The franchise requires that it be introduced by June 1, 1897.

CAPE CHARLES, VA.—The Town Council of Cape Charles has been given authority by the Legislature to issue $10,000 worth of bonds, the money to be used for general improvements in the city. The electric light question will be taken up and pushed as rapidly as possible.

WARREN, O.—The City Council has accepted the bid of the Warren Electric Light & Power Company for the contract to light the city. The cost is $80 for all-night lamps and $55 for midnight lamps, each per year. This will save the city about $1000 annually over the former contract.

BOSTON, MASS.—The gas and electric light commissioners have issued an order approving an issue by the Boston Electric Light Company of $200,000 mortgage bonds; the proceeds to be applied in payment of the cost of extensions of the company's plant made since July 1, 1895.

OLD FORGE, N. Y.—A syndicate composed of Victor Adams, Hon. Titus Sheard, Mr. Snyder and others, of Little Falls, have bought of Gorman & Crosby a half interest in the Old Forge House property, and propose to put in an electric light plant and a system of water-works.

LOWELL, MICH.—The City of Lowell has engaged Humphrey & Carr, of Detroit, as engineers for its electric light plant. Plans and specifications will be completed in time to receive bids early in February. The electric machinery will be run by water-power, located eight miles from the city.

CHICAGO, ILL.—Sealed proposals will be received by the Commissioners of Lincoln Park, until 2 p. m., Feb. 5, for furnishing two compound condensing engines, three 80-arc light dynamos, and appurtenances, dynamo belts, 225 arc lamps, and 100,000 feet more or less of conduit for underground service.

LOWELL, MICH.—Humphrey & Carr, of Detroit, have been engaged by the village of Lowell as the engineers for its proposed electric light plant. The plant will be operated by a water-power located eight miles from the town. The vote on bonding the village for the purpose was carried by 363 to 68.

TOPEKA, KAN.—The proposition of the Edison Company to light the city was rejected by the City Council. Councilman Drew figured that the city could operate its own plant several thousand dollars cheaper than it could let the contract. The specifications for the improvements to be made were filed.

SWARTHMORE, PA.—The Swarthmore Council has instructed the Highway Committee to advertise for bids. A strong effort will be made to have the work done by a local company, and it is possible that the capitalists of Swarthmore will be induced to furnish the money for the erection of a plant in the borough.

READING, PA.—A special committee of Councils, appointed for the purpose, has submitted a report on the advisability of the city owning its own electric light plant. The report states that a plant sufficient for electric lighting (public) can be erected at a cost of $60,000. The committee recommended the erection of a plant.

BLOOMFIELD, N. J.—The Bloomfield Township Committee held a meeting to consider the electric light bids presented at a previous meeting. The Light Committee, with the co-operation of the Franchise Committee, was directed to draw up the form of a contract and franchise to be further considered by the Township Committee.

THE HOME ELECTRIC HEATING COMPANY, Portland, Me., has been incorporated, with a capital stock of $500,000, for the purpose of manufacturing and dealing in machinery and processes for heating and cooking by electricity. Those interested are T. Henry Pearce, Samuel W. Clifford, Boston, Mass., and Edward K Millikin, Deering, Me.

SHIPPINSBURG, PA.—At the annual meeting of the Shippinsburg Electric Light Company, on Jan. 10, the following officers were elected: J. C. Rummel, president; J. C. Fleming, secretary, and C. J. Reddig, treasurer Mr. Reddig, however, who has been treasurer of the company since its organization in 1890, has since resigned from that position.

CONNEAUT, O.—The village authorities have under consideration the erection of a municipal plant, for which bonds have been granted, and the contract for the building let. One 50-light arc dynamo, one 1000-light alternator, one 150-hp engine, and one 100-hp boiler will be required for the plant. N. M. Currie, the superintendent, will give particulars.

HARTFORD, CONN.—Negotiations have been pending for several weeks between the Hartford Electric Light Company, capital $350,000, and the Hartford Light & Power Company, capital $150,000, the two Hartford electric light companies, for consolidation. It is reported that arrangements have been completed by which the former company absorbs the latter.

BERKELEY, CAL.—The management of the Berkeley Electric Lighting Company has undergone a change, brought about by the election of a new Board of Directors. The control of stock was recently acquired by T. T. Mason, and the directors of the company at their last meeting decided on a new board Many improvements will be made in the plant.

MILWAUKEE, WIS.—Judge Seaman, in the United States Circuit Court has ratified the contract made by Receivers Sheldon and Payne, of the Milwaukee Street Railway Company, with the city authorities for lighting the streets with electric arc lights of 2000 candle-power, stating in his order that it was for the best interests of the railway company to have the contract stand.

FRESNO, CAL.—A number of Eastern capitalists, of whom Jesse Grant, of San Diego, is a member, has been making surveys near the headwaters of the Kings River, for the purpose of utilizing the water-power to supply electricity to Reedley, Sanger and Fresno. The company is in no way associated with that now endeavoring to secure electric power from a reservoir on the upper San Joaquin.

JERSEY CITY, N. J.—Negotiations are said to be about complete whereby the Jersey City Electric Light & Power Company will be absorbed by the People's Electric Light & Power Company, which already controls the Newark Electric Light & Power Company and the Montclair Light & Power Company. The Jersey City company, which is about to be absorbed, is operating under a capital of $250,000.

ILION, N. Y.—Knowlton Brothers, of Watertown, have completed arrangements with the Harmon Machine Company for the erection of an electric power plant at a cost of over $100,000. The scheme is a gigantic one. They propose to harness the immense water-power of Black River at the big falls and generate electricity, and transmit it to the mills and factories along the banks and to business places within the city.

ST. LOUIS, MO.—The ordinance providing for burying the overhead wires which has been under preparation by the City Lighting Committee of the Board of Public Improvements for the past three weeks, was submitted to the Board at its session and adopted. It provides that after Jan. 1, 1900, the city shall have the privilege of cutting down all poles and overhead wires, and also provides a penalty against any person maintaining them.

PORT JEFFERSON, L. I.—The Port Jefferson Electric Light & Power Company has dissolved on account of internal dissensions. It was organized a few weeks ago with Mr. L. Chambers as president and W. T. Wheeler as secretary and treasurer. The capital stock was $7500, and at one time it was thought it would be necessary to raise it to $10,000, to satisfy the clamor of would-be investors. Some of those who had secured stock were asking a bonus of 20 per cent.

LOS ANGELES, CAL.—The Los Angeles Edison Light & Power Company proposes to carry on a general electric lighting and power supplying business. The head of the company is Charles R. Lloyd, of San Francisco. The promoters of the enterprise say that the plant to be put in will be thoroughly up to date. It is expected to spend $500,000. The wires will be laid underground in the business part of the city. Several Los Angeles men are interested in the enterprise.

BRIDGEWATER, MASS.—A special meeting was held last week to discuss whether the contract with the Bridgewater Electric Light Company should be annulled and a new one made. President Wiman, of the electric light company stated that if the town would make a new contract, agreeing to take 10 more arc lamps, the company would give eight and one-half amperes of current instead of six and one-half as at present, thus largely increasing the light given by all the lamps.

COLUMBUS, O.—Bids for lighting the city were opened last week. The Edison Electric Light Company submitted two propositions. The first proposed to do the lighting from May 1 until the 1st of January, 1897, at $6.67 per lamp per month; after Jan. 1 the rate of $107 per lamp per year. The second proposition is to light the district bounded by Naghten Street, Fourth Street, Livingston Avenue and Scioto Street, at $85 per lamp per year, using their own conduits, all outside of that district at $110 per lamp. In these proposals, as well as in the other bids, all-night lighting is contemplated, and so bid. The Citizens Electric Light Company bid $6 per lamp per month from May 1 to Jan. 1, 1897 after that date $97.75 per lamp per year. The Columbus Electric Light & Power Company bid $6.25 per lamp per month until Jan. 1, 1897; $102.50 per lamp per year after Jan. 1.

THE ELECTRIC RAILWAY.

GOLDEN BRIDGE, N. Y.—It is rumored that a trolley line from Golden Bridge to Danbury is to be established.

ARLINGTON, MASS.—A movement is on foot to build an electric railway from Arlington to Winchester, a distance of four miles.

NASHUA, N. H.—The Railroad Commissioners have granted permission to the Nashua Street Railway Company to extend its system.

WARREN, O.—A company has been incorporated, and the proposed electric railway to connect this place and Sharon, Pa., is to be built.

WHEATON, MD.—The electrical road enthusiasm has again been revived, and land owners are extending to the project great encouragement.

BUFFALO, N. Y.—The Councils have refused to grant franchises to the recently organized railway company which proposed to lay miles of track in this city.

LITTLE NECK, L. I., N. Y.—Little Neck will have trolley accommodations soon, a company having secured the right of way across the Douglaston meadows.

UNION BRIDGE, MD.—It is reported that an electric railway is to be built from some point on the Western Maryland Railway to Mount Fairview, in Washington County.

ORANGE, N. J.—The South Orange Village Board of Trustees has passed an ordinance giving a franchise to the Newark & South Orange Street Railway Company to operate a trolley line on Valley Street.

JAMAICA, L. I., N. Y.—Application has been made to the Queens County Board of Supervisors by a Mr. Hallock, who is said to represent the Flynn syndicate, for a franchise to operate a single track trolley road on the Jamaica and Hempstead turnpike.

ST. LOUIS, MO.—More than 300 laborers, employed by John A. Seely to lay tracks for the new Southern electric line of the People's Railway Company, went on a strike last week through a misunderstanding, upon the explanation of which they returned to work.

READING, PA.—The Board of Directors of the Reading & Southwestern Railway Company will reorganize next week. President James Shepp stated that as soon as the season for resuming the construction of the extension of the line arrives work will at once commence.

BROOKLINE, MASS.—The West End Company and the newly organized Brookline Street Railway Company have rival petitions before the Brookline selectmen for permission to lay down an electric railway on Boylston Street from Cypress Street to Chestnut Hill Avenue.

WEST TROY, N. Y.—At the next meeting of the village trustees of West Troy, the Cohoes City Railway will make application for a franchise to extend its tracks on Twenty-sixth Street, Third Avenue and Nineteenth Street so that connection can be had with the Albany City Railway.

PLATTSBURG, N. Y.—The Plattsburg Village Trustees have granted a franchise to the Plattsburg Traction Company, to build and operate an electric street railway in the village. The company expects to have the road in operation between Plattsburg and Bluff Point by July.

HINGHAM, MASS.—Definite steps have at last been taken looking to the building of an electric street railway through the towns of Hingham and Hull, which will give direct communication with Downer Landing and Nantasket Beach for the territory between Brockton, Boston and the intermediate towns and villages.

FRANKFORD, PA.—The extension of the Holmesburg, Tacony & Frankford Passenger Railway from Bridesburg, along the State road, through Tacony and up Bridge Street, to Frankford Avenue, has been opened. The present terminus of the road is at Red Lion. Arrangements are being made to extend the tracks up the road to Bristol and it is expected to have the road in operation by Summer.

ROCKFORD, ILL.—The court has formally discharged the Title Guarantee & Trust Co. as receiver of the West End Street Railway Company, and the property has been turned over to the new owners, the Rockford Traction Company, of which Mr. John Farson, of Chicago, is president. The people of Rockford are much pleased with the new management, and believe that with Mr. Farson as president they will have the best street railway service possible.

BERLIN, ONT.—The Berlin & Waterloo Street Railway Company has undergone a change in proprietorship. The majority of the stock, which was held by Mrs. Burt, of New York, has been disposed of to Messrs W H. and E. C. Breithaupt, who now have the controlling interest. Mr. E. Carl Breithaup, as president of the road, will take general charge with Messrs. T. M. Burt and T. E. McLean in the management. Mr. E. Carl Breithaupt is also president of the company which proposes to build the Grand Valley Street Railway line.

PERSONAL.

BUT A FEW WEEKS OLD under his new name, Mr. Christian G. Rach has nevertheless been known in electrical circles for almost 15 years. By an order of the court his name was changed on Jan. 18 from Gustav A. Kornetzke, through a request made by the late father of his mother, Mr. George Rach, who died without leaving any male descendants bearing his name. Mr. Kornetzke was born in Blumenau, Prussia, Dec. 3, 1865, and in December, 1880, he came to this country. In the Fall of the same year he accepted employment with the Electric Tube Company, of New York City, of which at that time Mr. Kreusi was general manager; the company was subsequently absorbed by the Edison Machine Works, and afterward incorporated in the Edison Electric Lighting Company, and is now known as the Underground Tube Department of the General Electric Company, of which Mr. Kornetzke is the manager. During his long connection with the manufacture of Edison tubes and tube fittings Mr. Kornetzke has made numerous important improvements in details of the apparatus, as well as in methods of their manufacture. Mr. Rach has a host of friends among the manufacturers, superintendents and electricians of all the Edison lighting companies throughout the country, who will be interested in learning of his change of name.

CHRISTIAN G. RACH.

MR. GEORGE F. CHISM, formerly with the Standard Engineering Company, of Albany, N. Y., is now connected with Mr. Le Grand Brown, of Rochester, N. Y. Mr. Brown is making a specialty of electric railways, and Mr. Chism will devote his special attention to the department of electric railway power plants.

ELMER A. HOVEY, master mechanic of the Chicago Street Railway Company, died of consumption at Albuquerque, N. M., Jan. 13, 1896, aged 34 years

MR. G. C. SILLAR, manager of the Falcon Works at Leicestershire, England, of the English Brush Electrical Engineering Company, (of which Mr. W. M. Mordey is the designing engineer) is on a visit to the United States, during which he will inspect the more prominent electrical works and some of the recent engineering installations.

Trade and Industrial Notes.

DIEHL & CO. have removed their place of business from 385 to 561 Broadway, New York.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., will build the power house for the Brunswick Traction Company, at Millton, N. J. The engine room will be 64 ft. long and 85 ft. wide, and the boiler room 45 ft. wide and 48 ft. long. The side walls are of brick and the roof trusses of iron.

A. O. SCHOONMAKER, 158 William Street, New York, has issued a standard price list of mica, uncut, cut to sizes and stamped for commutator segments. The East India mica used comes direct from the original sources in India, and has the advantage of always being perfectly free from iron and splitting to a uniform smooth gauge.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, of St. Louis, has already started work on its alternating-current fan-motors of various types, and intends to be in shape to fill all orders at the proper time. The most marked improvements will probably be in its ceiling fan, about which there will be something to say in a month or two.

MR. GEORGE CUTTER, the Rookery, Chicago, Ill., has issued a neatly gotten up set of "Handy Wiring Tables," giving data required in the every-day work of electricians. The more simple electrical formulas are included, and also a new form of wiring table, using a much simplified principle. The table is based upon the number of lamps multiplied by the volts lost, a single table thus being made to answer for 52, 100, 110 and 220 volt circuits.

THE EASTERN MACHINERY COMPANY, New Haven, Conn., has purchased the plant, patents and good will of the Frisbie Elevator & Manufacturing Company, and with largely increased facilities and conservative management, the new company offers ideal advantages in the lines of elevator and friction pulleys for many years successfully manufactured by its predecessors. Prompt and particular attention will be given to repair work of all kinds, thoroughly competent mechanics being sent to handle break-downs.

THE STERLING VARNISH COMPANY, Pittsburg, Pa., was incorporated about two years ago for the purpose of putting into practical use a number of processes that had been experimented with for several years prior to that time by the president, Mr. James Todd. These processes relate to the refining of linseed oil and the manufacture of insulating varnishes. The success with the later in electrical work has been very great, it being claimed that the Sterling insulating varnish is now used in 90 per cent. of the electrical factories of the country.

STEAM APPLIANCES.—In a handsome catalogue, the Hine & Robertson Company, 68 Cortlandt Street, New York, describes and illustrates a number of its steam specialties, including the Robertson-Thompson indicator, the Victor indicator reducing wheel, the standard planimeter for working up indicator cards, the Hine separator, the Robertson exhaust pipe head, and several other appliances that have become well known in steam engineering circles. A number of pages are given to a very complete description of the Robertson-Thompson indicator, which will be found of service to those interested in the subject.

CAR HEATERS.—The Whittingham Electric Car Heating Company, Equitable Building, Baltimore, Md., is having much success with its car heater. Mr. D. Thompson, general superintendent of the Ithaca, N. Y., Street Railway Company, in a recent letter, expresses much satisfaction with the Whittingham heaters, which, he says, particularly impresses the patrons of the road by being cleanly and sightly, and the heat being evenly distributed throughout the entire car and not intense at one point, as is the case with most other car heaters. Recent sales of heaters have been made to the electric railways in Baltimore (two roads), Pittsburg, Pa., Ithaca, N Y., Cortland, N. Y, Montreal, Canada, Racine, Wis., Terre Haute, Ind., Tampa, Fla., Winnepeg, Man., and Chicago and Bloomington, Ill.

JAMES BROWN & SON, 114 Wood Street, Pittsburg, Pa., have recently carried out some important electrical installations, among others the equipment of the Schenley Park Casino, the Indiana (Pa.) State Normal School, the Barclay and Farmers' Safe Deposit Bank Buildings at Greensburg, Pa., the Gladden & Halen Building at McDonald, Pa., and the Smith Building at Pittsburg. At present they are engaged on the electrical construction work of the M. P. Board of Publication at Pittsburg. During 1895 the firm equipped with electrical appliances no less than 16 churches. As agents of the Akron, (O.) Electrical Manufacturing Company, they carry in stock a full line of dynamos and motors, and are makers and dealers in lamp fixtures and electrical supplies of all descriptions and give special attention to electrical repair work, including armature rewinding.

A LAMP VALENTINE.—The manufacturers of the Packard lamp recently received from one of their customers an interesting souvenir in the shape of an old burned-out Packard lamp together with a valentine card on which was written: "This lamp has been in constant use for two years and three months." Accompanying the valentine was the following letter from the donor, Mr. C. F. Hesser, vice-president and general manager of the Cincinnati Gas Light & Coke Company: "I herewith send you a valentine souvenir which would be a curiosity if placed in your new catalogue. Trusting you may appreciate this little memento and keep it for future reference, we are, etc." The Electric Appliance Company, of Chicago, has had the souvenir on exhibition at 242 Madison Street, where it has attracted considerable attention. A lamp which has burned over 19,000 hours is certainly entitled to more than ordinary respect.

MECHANICAL COMPUTERS.—In a circular the Cox Computer Company, 173 Greenwich Street, New York, gives a list of the various special computers manufactured by it. These instruments are mechanical devices, by means of which formulas in constant use in mechanical, electrical and other engineering

professions can be rapidly and mechanically solved. They consist of several parts, including a foundation plate, a revolving disc, and, when the formula consists of more than four factors, of a revolving segment or arc, upon each one of which are printed scales corresponding to the various factors in the formula; by turning the disc or segment around and bringing the values of the different known quantities opposite each other, the values of the unknown can be immediately read off. Among the special computers are ones for the calculation of engine and boiler horse-powers, belting, shafting, electrical wiring, horse power and efficiency.

THE ORIENT ELECTRIC COMPANY, of Youngstown, O., is rapidly becoming an important factor in the manufacture of incandescent lamps. It was incorporated under the Ohio State laws about three years ago. Last December it was reorganized with Mr. N. L. Norris, a well-known lamp man, as manager and also secretary and treasurer; Mr. Wick C. Gunns, president; Mr. B. A. Manix, vice-president, and Mr. C. N. Sadler, superintendent, the latter having occupied a similar position with the New York & Ohio Company at Warren, O., for a number of years. The Orient Company manufacture only a high-grade lamp, and that its policy in this respect is a wise one, it believes, is shown by the very high reputation which its lamp has assumed. The company has been running its factory day and night for the past two months in order to meet the demand, which is constantly increasing. One of the features adopted by the company in the manufacture of its lamps is the testing of every lamp three times by three different persons, and with as many different instruments before any are permitted to leave the factory. The factory is 150 feet long and 100 feet wide, and is equipped with the most modern machinery and instruments necessary for the manufacture of high-grade lamps. A branch office has been opened at the Monadnock Block, Chicago, with Mr. Fayette S. Lane in charge.

Business Notices.

A GOOD OPENING.—The Ira Cornwall Company, St. John, New Brunswick, wants experienced electrician. See advt.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

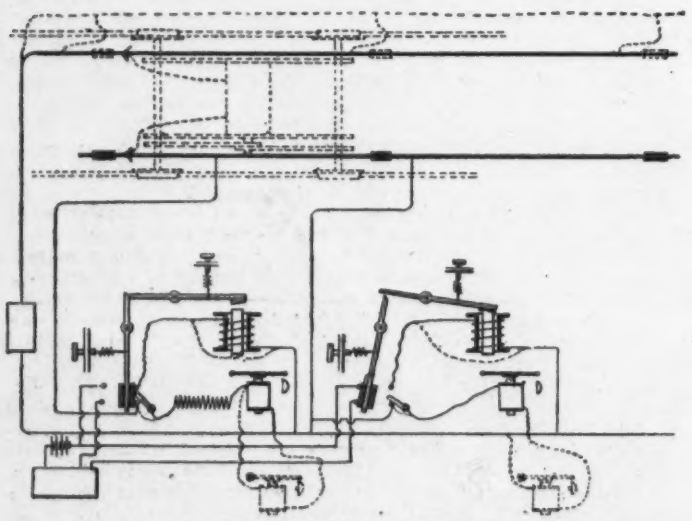
UNITED STATES PATENTS ISSUED JAN. 21, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

553,264. ELECTRIC RAILWAY; W. M. Schlesinger, Philadelphia, Pa. App. filed Dec. 21, 1886. In an electric railway, the combination of a working conductor comprising a series of insulated or disconnecting sections, a series of separate feeding conductors for supplying said sections, conductors constituting paths of high and low resistance interposed in said feeding conductors, safety devices in the conductors of low resistance and return circuit connections opposed to said sections.

553,296. ART OF MANUFACTURING ELECTRICAL INCANDESCENT CONDUCTORS; J. W. Aylsworth, Newark, N. J. App. filed July 27, 1894. The described method of depositing any of the hereinbefore named refractory metals upon a surface, which consists in subjecting a halogen compound of such metal to the action of heat, and a reducing vapor or gas as hydrogen, and at the same time electrically heating the surface upon which the metal is to be deposited.

553,304. ELECTRIC GAS LIGHTING APPARATUS; H. C. Farquharson, New York, N. Y. App. filed Nov. 4, 1895. The combination with the chimney in the gas burning lamp, of a spark point holder formed of a refractory substance that is a non-conductor of electricity, such holder being perforated and the spark-points introduced in the perforations, screws for holding the spark-points and wires for the electric circuit clamped to the screws.



No. 553,264.—Electric Railway.

553,328. INCANDESCING ELECTRICAL CONDUCTOR; J. W. Aylsworth, Newark. N. J. App. filed July 27, 1894. An electrical conductor, formed of the so-called elementary substance "niobium" deposited upon a conducting base or support such as carbon.

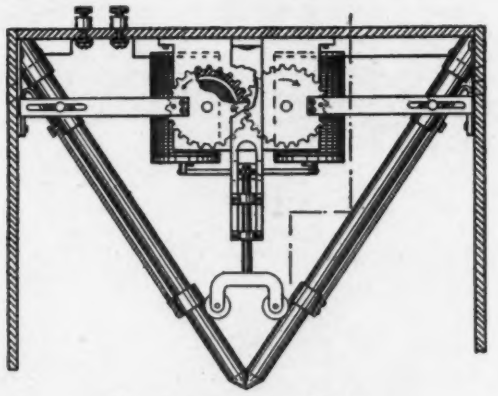
553,330. ELECTRIC GAS LIGHTING APPARATUS; H. W. Brinckerhoff and H. C. Farquharson, Brooklyn and New York, respectively. App. filed April 8, 1895. The combination with a gas burner and its chimney, of spark points and conductors for directing a current of electricity for lighting the gas, and a shield and a thermostatic device for acting upon the shield to move the same and protect the spark points when the gas is burning.

553,335. ELECTRIC ARC LAMP; E. H. Crosby, Boston, Mass. App. filed May 27, 1895. In an electric arc lamp two diagonally arranged carbons mounted to move longitudinally in combination with electrically actuated mechanism for spreading the adjacent ends of said carbons to strike the arc; and mechanism connecting the upper portions of said carbons for automatically feeding the same longitudinally and conjointly.

553,364. TELEPHONE CALL; J. G. Smith, New York, N. Y. App. filed Aug. 17, 1895. The combination with a magneto or dynamoelectric machine, of a toothed or notched wheel to be operated thereby, and a vibratory or oscillatory switch or contact arranged to be continuously vibrated or oscillated by the teeth of the wheel during a single rotation of said wheel.

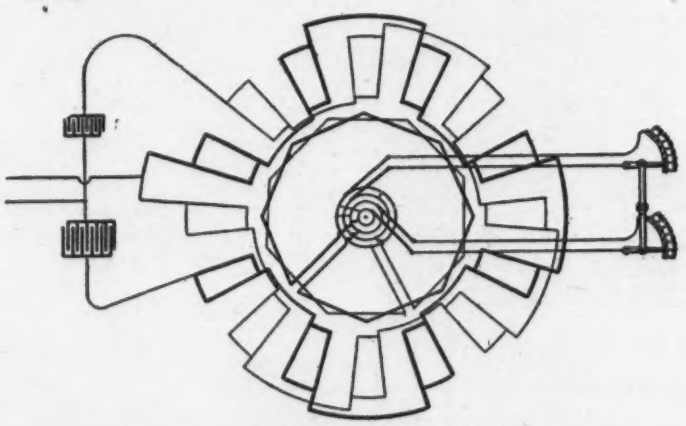
553,410. TROLLEY; W. Kaup, Newark, N. J. App. filed June 7, 1895. The combination with the trolley pole and wheel, of guard carrying levers arranged on opposite sides of said wheel, springs holding said levers in normal position and guards pivoted on said levers and free to gravitate a limited distance when the trolley pole is reversed.

553,446. MAGNETIC EXTRACTING AND SEPARATING MACHINE; F. J. Barnard, J. C. Moore and J. D. Atkinson, Seattle, Washington. App. filed Feb. 27, 1895. In a magnetic separator, the combination of a frame, a suitable non-magnetic casing, having a suitable top by which the casing is secured to said frame, and a number of perforations in the casing for permitting a free circulation of air, a number of magnets secured to said top and projecting downwardly within the casing and conveyor belt passing beneath said casing.



No. 553,335.—Arc Lamp.

553,452. TELEPHONE; S. A. Dinsmore, Chicago, Ill. App. filed April 22, 1895. The combination in a telephone of a movable transmitter, a signaling device, a disc or wheel associated with said transmitter so that the motion of said disc or wheel moves the transmitter, and an operative connection between said disc or wheel, and the operating handle of the signaling device.



No. 553,469.—Alternating-Current Motor.

553,469. ALTERNATING-CURRENT MOTOR; Maurice Hutin and Maurice Leblanc, Paris, France. App. filed Nov. 17, 1892. The method of producing constant torque in alternating-current motors having rotary fields produced by currents with shifted phases, consisting in closing the armature circuits upon like resistances and reducing and increasing from moment to moment the said resistances, both to the same extent, as the speed of the armature increases and decreases, respectively.